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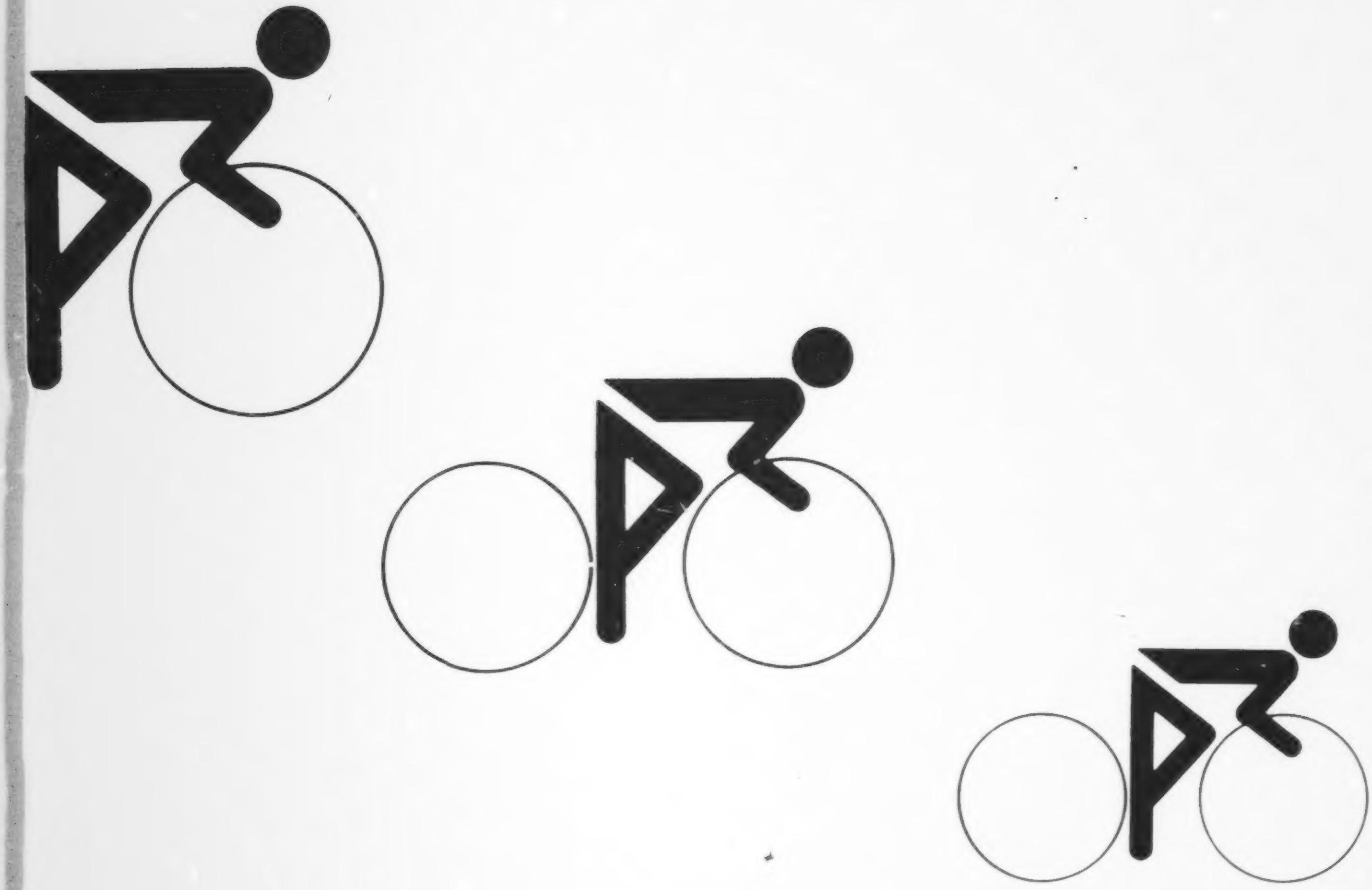

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16. ABSTRACT

This report is one of a series prepared in accordance with Section 108(f) of the Clean Air Act, as amended in August 1977. This document is intended to assist urban areas with better utilization of bicycle strategies in their State Implementation Plans to reduce air pollution, and in integration of such strategies with their transportation system management and air quality planning programs as required by EPA, FHWA and UMTA.

This document summarizes major factors affecting the level of bicycle use at the local level, and outlines measures to be considered for inclusion in a comprehensive bicycle transportation strategy. Quantitative data on bicycle program effectiveness is reviewed, and evaluation of potential air quality and energy impacts of bicycle strategies is discussed. Implementation considerations are included, such as legislation, institutional structure, and funding sources. Finally, brief case studies of programs implementing bicycle strategies are presented for Davis (California), Madison (Wisconsin), Denver (Colorado), and the states of North Carolina and California.

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EXECUTIVE SUMMARY

The Bicycling and Air Quality Information Document is one of a series of reports mandated by Section 108(f) of the Clean Air Act, as amended in 1977. The major purpose of these reports is to provide information on measures to control air pollution caused by automobile emissions.

This document is intended to assist officials and citizens in evaluating the use of bicycle strategies as transportation measures in state and local air quality planning processes. The document indicates how bicycle use may be increased through engineering, safety education, enforcement, and encouragement. Air quality, energy, economic, and health impacts of bicycle measures are discussed. Steps for implementing bike programs through existing planning procedures are delineated. Finally, five case studies illustrate strong bicycle program implementation.

Increasing bicycle use has obvious appeal as an air quality measure for several reasons. First, since trips made by bicycles do not result in hazardous emissions, every bicycle trip which substitutes for auto travel results in cleaner air. Bicycle strategies generally appear to be among the most popular transportation measures, when instituted. This is not surprising since many riders say a major motivation for using a bicycle is for enjoyment, and because bicycle riding provides an opportunity for physical exercise at the same time a trip is made. Other appealing features of bicycle strategies include energy conservation through reduced demand for gasoline. In addition to conservation, bicycle riders save the money they would otherwise pay for gas. Finally, in some situations such as congested downtown areas, bicycle travel is faster than car travel. Use of bicycles rather than cars in urban areas

Section 1: BACKGROUND

Section 1 summarizes use of bicycle strategies as transportation measures in the State Implementation Plans (SIPs). The many factors which affect existing bicycle use and potential modal shift--exclusive of new bicycle programs--are also discussed in this section.

Seven of the first round SIPs included bicycle strategies. Areas covered by these strategies included Utah (Provo), Colorado (Denver), the Washington, D.C. area (including the northern Virginia and Maryland suburbs), Maryland (Baltimore), Massachusetts (Boston), Washington (Spokane), and Pennsylvania (Pittsburgh and Philadelphia). Most of these areas implemented or are in the process of implementing part or all of their plans. Air quality impacts associated with the bicycle strategies have not been specifically examined. Several areas found that the bicycle strategies were among the more popular transportation measures.

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A second round of SIPs and transportation measures were due this year for areas whose pollutants still exceed maximum levels established by EPA. As of September 1979, over 80 urban areas had indicated use or study of bicycle strategies as part of their transportation measures to reduce air pollution. The bicycle strategies mainly concentrate on physical facilities such as bikeways and parking.

It is estimated that almost half the U.S. population uses a bicycle at least once a year. If the local environment is favorable (e.g. moderate weather and terrain), bicycle programs can encourage these riders to made additional trips by bicycle rather than car, by removing deterrents such as unsafe riding conditions and lack of secure parking facilities. In areas including Davis, California, and Madison, Wisconsin with such environments and strong bicycle programs, a relatively large percentage of all trips are currently made by bicycle. Approximately 13% of all vehicle trips are made by bicycle in Madison and over 25% in Davis.

European bicycle use provides an indication of bicycle potential given favorable conditions. The bicycle is the major mode of transportation in the Netherlands. Modal split data for twelve cities in northern Europe indicates the percentage of bicycle trips of all modes (including foot) ranges from 5% in Marseille (France) to 45% in Tilburg (Netherlands).

The U.S. bicycle transportation literature indicates that at least 27 factors, exclusive of new bicycle program impact, can be expected to affect the level of bicycle use.

FACTORS ASSOCIATED WITH BICYCLE USE

Physical Environment

- Size and density of urban areas affecting trip length
- Climate
- Terrain
- Hours of daylight
- Air Quality
- Safety Hazards
- Traffic Volumes
- Existing facilities for biking
- Aesthetics

Social Environment

- Social organization and use of time affecting trip purpose
- Crime
- Peer group support for bicycling

Other Transportation Alternatives

- Types
- Convenience
- Cost
- Comfort
- Safety
- Visibility

Individual Population Characteristics

- Income
- Age
- Bicycle riding skill level
- Physical condition
- Knowledge and perception of transportation options
- Trip mode preferences
- Valuation of time
- Valuation of exercise
- Fear of accidents

The literature on the impact of these factors is reviewed in Section 1. Impacts vary widely among urban areas in the U.S., making local estimation of potential impacts necessary.

Section 2: BICYCLE PROGRAMS

Section 2 contains a summary of reasonably available control measures (RACMs), as required by the 1977 Clean Air Act amendments. A comprehensive approach to developing bicycle measures is stressed. For example, one bike path will probably have little effect. Other complimentary measures are needed, such as engineering, safety education, enforcement, and encouragement.

Physical facility improvements for bicyclists are discussed under the engineering category. Bikeways, parking facilities, supporting facilities such as parallel grate replacement or traffic signals, and maintenance of facilities are examples of engineering measures.

The safety education category covers adult bicyclist training, instructor training, and police training. Juvenile bicycle safety education is also included, since some of the bicycle trips made by this age group substitute for trips in which the child would be driven by car.

Police training programs, assignment of special safety officers, bicycle peer courts, and bicycle registration are illustrations of enforcement measures currently in use in bicycle programs.

Finally, marketing and publicity activities which emphasize particularly enjoyable aspects of bicycling, such as exercise and money-saving benefits are summarized under the encouragement category. Activities include employer incentive programs, media coverage, and bike maps.

Section 3: EVALUATING BICYCLE STRATEGY IMPACT

The results of a literature search on bicycle program effectiveness are discussed in Section 3. Evaluation of bicycle programs for overall program effectiveness, and for air quality, energy, economic, and health impacts is stressed.

The literature search utilizes one primary and six secondary measures of effectiveness, including modal shift from auto trips to bicycle trips, and changes in travel time, bicycle accidents, knowledge retention, behavioural change, bicycle theft, and bicycle returns. Little quantitative documentation of program impacts could be located. Further, methodological questions were raised by much of the literature available.

Because of the absence of a reliable literature on bicycle program effects, the importance of local baseline surveys, comprehensive bicycle program implementation, program evaluation, and publication of outcomes is stressed. Localities implementing and carefully evaluating bicycle programs will make a national contribution if the results are disseminated.

In the absence of reliable quantitative data on potential program impacts, hypothetical examples illustrate air quality and energy impacts of bicycle strategies. Such strategies have greater potential air quality impacts than simple modal shift percentages might imply. These increased impacts are due to inefficient operation of the automobile for the type of travel which bicycling is most likely to replace. Such auto travel is characterized by short trips, slow speeds, cold starts, and stop-and-start driving. Such urban automobile trips result in higher emission rates for carbon monoxide (CO), hydrocarbons, particulates, lead, sulfate, and asbestos. A hypothetical example illustrates how a net modal shift (autc drivers to bike riders) could result in a total CO reduction of 5.1%.

Survey results are also presented in this section which indicate that in Pennsylvania, over half of all bicycle trips substitute for car trips (either as a driver or passenger). Only 2% of the bicyclists would have taken a bus. Over 30% of those under 15 would have been a passenger in a car. If this pattern holds among riders taking additional trips, and among new bicycle riders, the major modal impact of bicycle strategies for all ages will be to reduce auto travel.

Because most toxic auto emissions disperse widely over urban areas, a broad range of bicycle strategies will have a positive impact on air quality. Such strategies could be appropriately targeted at a broad range of trip types--including recreational, school, work, and utility--taken throughout the entire area.

Carbon monoxide emissions, however, tend to be highly localized, with peak levels generally occurring during rush hour. Commuter travel would be the logical target for bicycle strategies to reduce CO violations. However, increasing bicycle travel during periods of peak emission production raises questions about the health effects of such exposures on bicyclists. A literature review on the effects of emissions on bicyclists indicates that until further research is conducted on the health effects of bicyclist exposure to pollutants, no firm conclusions can be drawn.

Gasoline consumption, like auto emissions, is disproportionately higher for the short urban car trips for which bicycle travel can substitute. Therefore, successful bicycle strategies not only will save fuel, but will save more than would be indicated by simply looking at trip or mileage shifts alone.

In addition to air quality improvements and gasoline savings, bicycle strategy impacts include positive economic and health effects. For example, a 7% regional economic multiplier effect has been calculated for the McElroy-Sparta bicycle trail system in Wisconsin. Regular bicycling (e.g. commuting) can provide the minimum aerobic exercise recommended by some doctors for better health.

Potential benefits of bicycle strategies should be weighed against costs. Section 4 presents several illustrative comprehensive bicycle strategies of differing cost levels. Other types of costs such as those associated with travel time changes are also discussed.

Bicycle measures can effectively compliment and support other transportation measures. For example, bus patronage increased in San Diego when bicycle racks were installed on the busses. Other complimentary uses of bicycle programs are summarized in Section 3.

Section 4: PLANNING AND IMPLEMENTATION

The best bicycle strategy is useless unless it is effectively implemented. The planning and implementation process in many of the most active bicycle programs is characterized by strong legislation and political support, clear assignment of lead responsibility (e.g. to a bicycle coordinator), cooperation and coordination among supporting agencies, and availability of funding for the bicycle program.

Section 4 discusses types of legislation which can assist in implementing bicycle strategies. This legislation includes a model ordinance or statute authorizing a bicycle program, and consistent laws governing bicycle operation. Examples of bicycle facility legislation include the bicycle provisions of the new Palo Alto zoning ordinance, and the set-asides of highway funds for bicycles in the states of Oregon and Washington. Bicycle registration, developer guidelines, and legislative adoption of bicycle plans with commitment to implement are also reviewed.

Bicycle coordinators have been appointed to head some of the strongest bicycle programs. Specific assignment of implementation responsibility to a coordinator is particularly useful in bicycle strategies because such a large number of organizations and individuals can lend support.

Bicycle advisory committees, bicycle organizations, local elected officials, and local, state and federal departments have all provided support during implementation of existing bicycle programs. Specific sources of potential in-kind or financial support are summarized in the section. Finally, the importance of including bicycle strategies not only in the State Implementation Plan, but in the DOT-assisted planning process is stressed. Bicycle programs must be included in the Unified Planning Work Program (UPWP) and other appropriate DOT plans to receive DOT financial assistance and to receive EPA 175 (Urban Air Quality Grant) funds. Potential Federal funding sources for bicycle programs and facilities are listed in Appendix E, along with an actual example of combined facility funding in Denver.

Section 5: CASE STUDIES

Five case studies are included which illustrate effective implementation of bicycle strategies. The programs described provide examples of local, regional, and state programs, and include: Davis (California), Madison (Wisconsin), Denver (Colorado), and the states of North Carolina and California.

The programs exhibit many common features including strong enabling legislation, clear assignment of responsibility, adequate levels of funding, and highly motivated program administrators. However, the programs also illustrate how different the initial motivating force for programs may be. Public pressure and use of the political system, support by bicycle organizations, and the efforts of individuals were instrumental during the early phases of various programs. All, however, have experienced public, political, and administrative support once initiated.

SECTION 1: BACKGROUND

1.1 Objective and Contents of Report

This document, mandated by Section 108(f) of the Clean Air Act, as amended in 1977, is one of a series on measures to control transportation emission-related pollution.

The purpose of this report is to provide information on the potential role of bicycle strategies[1] in reducing air pollution. More specifically, the document is intended to help air quality planners, transportation planners, local officials, and citizens decide whether a bicycle strategy should be included as a transportation measure in the state and local air quality planning process. The report is primarily intended to assist areas without experience with bicycle programs. Based on literature reviews and discussions with bicycle program administrators, the report summarizes bicycle program information which may directly or indirectly affect air quality.

Bicycle strategies warrant serious consideration for several reasons. Trips made by bicycles do not create air pollution or use scarce gasoline. An estimated 40-45%[2] of Americans already own or have access to and use bicycles for some types of trips. Every new trip taken by bicycle instead of car will result in direct gasoline savings, emission reduction, and air pollution improvement. Some bicycle programs are low cost, so even a small number of new bicycle trips resulting from the program may justify the expenditure. Finally, bicycle strategies appear to be one of the most popular transportation measures for use in air quality planning.

The report contains five major sections. The remainder of Section 1 briefly reviews the air quality planning requirements in the U.S. and summarizes information on current bicycle use.

Existing bicycle programs are reviewed in Section 2, providing information on reasonably available control measures (RACMs) as stipulated by the 1977 Clean Air Act amendments. Programs are discussed by four major categories: engineering, education, enforcement and encouragement.

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[1] A bicycle strategy means a comprehensive set of bicycle measures or programs, such as provision of bicycle parking and riding facilities, along with implemention of education, and enforcement programs.

[2] Bicycle Manufacturers of America estimate.

Evaluation of bicycle program impacts is discussed in Section 3. Measures of effectiveness are used to assess the air quality related impacts of existing programs. Evaluation of air quality, energy, economic and health benefits are also discussed.

Many localities have invested in bicycle program development but have never implemented the plans. Some of the major reasons include inadequate funding, lack of political support and insufficient public education. Section 4 discusses reducing or removing such obstacles to implementation. Implementation considerations are particularly important for air quality planners, since the agency preparing the air quality plan normally has no powers to implement bicycle programs directly.

Finally, several case studies are included to illustrate local experiences with bicycle programs. Experience in Davis (California), the Madison (Wisconsin) and Denver (Colorado) metropolitan areas, and the states of North Carolina and California are described in Section 5.

1.2 Background

1.2.1 Air Quality Control and Transportation Measures

Although air quality legislation was passed in 1955 and 1963, it was not until the 1967 Clean Air Act that national regulation of emissions from new motor vehicles was permitted. The 1967 Act called on each state to set standards for air quality and a schedule for compliance. By 1970, the Clean Air Act Amendments required the new Environmental Protection Agency to set national ambient air quality standards.

Primary ambient air standards (to protect health) and secondary standards (to protect welfare) were set by EPA in 1971 for six pollutants: carbon monoxide, hydrocarbons, particulate matter, nitrogen dioxide, sulfur oxides and photochemical oxidants. The legislation also required motor vehicle manufacturers to reduce carbon monoxide emissions in new vehicles 90% by 1975 and nitrogen oxides by the same percentage by 1976. Attainment dates for all these standards have been extended several times, with current deadlines in the 1980s.

States containing areas not meeting the primary or secondary ambient standards in 1970 were required to prepare a State Implementation Plan (SIP). This Plan was to outline the measures which would be taken to control stationary and transportation related pollutants so air quality standards would be achieved by the deadline.

The portions of the SIP dealing with emission reduction from transportation sources were called Transportation Control Plans (TCPs). Most urban areas with heavy automobile travel could not meet air quality standards without developing measures to reduce transportation emissions.

Bicycle strategies were included by EPA in some of the TCPs, where public support was expressed at hearings, because bicycle travel is non-polluting and air pollution from autos could be reduced if more people biked instead of driving. The Utah (Provo), Colorado (Denver), Washington, D.C., Maryland (Baltimore), northern Virginia, Massachusetts (Boston), Washington (Spokane), and Pennsylvania (Pittsburgh and Philadelphia) TCPs all contained bicycle measures (1)*. Most of these areas implemented or are in the process of implementing part or all of their plans. None of these areas has specifically examined air quality effects attributable to bicycle strategy implementation.

Unlike some unpopular transportation measures, especially those restricting auto travel, bicycle programs generally met with public acceptance. A recent Boston air quality document stated that:

> It is generally considered that bikeways are an acceptable program in the public's eyes. The low cost and low disruption to present transit patterns add to its favorable impact and acceptability. The recreational aspect of bicycling is a further positive factor (2).

Similarly, an official in Denver commented:

> Experience we have had with transportation control strategies in Denver over the past four years would seem to indicate that strategies such as bicycle lanes may be the most implementable and publicly acceptable of any strategies proposed to date for Denver (3).

Generally, the first round of transportation strategies including bicycle measures were not implemented rapidly for a variety of reasons. These reasons included the limited time period available for preparation of these plans, limited data on the potential effectiveness and socioeconomic impact of various measures, and a lack of awareness of the hazards associated with polluted air. Implementation was further impeded in some areas because of confusion over the legislative requirements and funding sources, or unclear assignment of responsibilities.

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*References are given at the end of each of this report's sections.

In large part because of these problems and the failure of many urban areas to reduce pollutants to a level considered an acceptable health risk, the Clean Air Act was amended in 1977. The Clean Air Act, as amended in 1977, called for preparation of new State Implementation Plans.

The first step in preparing the new air quality plans was to identify non-attainment areas. The oxidant standard was the most widely violated with only one of the 208 urban areas in the U.S. of over 200,000 population, Honolulu, meeting the attainment standard. Of the remaining smaller 103 urban areas, 97 were in violation and 6 were presumed to be pending further data (4). A recent change in the oxidant standard in 1979 reduced the number of non-attainment areas (5).

Unlike oxidants which disperse over large geographic areas, high carbon monoxide (CO) levels tend to be localized, particularly in downtown areas with heavy traffic. Continuing CO violations were noted in 189 urban counties or parts of urban counties.

Total suspended particulate violations, like oxidents, are generally dispersed. State reports to EPA indicated violations in all or part of 408 counties.

After identifying non-attainment areas, the next step in meeting requirements under the 1977 Clean Air Act is for each state to develop and implement a plan (SIP) to bring non-compliance areas up to standard by December 31, 1982. If a State demonstrates that attainment of standards for carbon monoxide and photo chemical oxidants is not possible by 1982, then an extension of the deadline to December 31, 1987 may be granted by EPA. The new State Implementation Plans were due January 1979. Approval or disapproval of the plans by EPA is taking place during 1979. Analysis of the effectiveness of the transportation control plans must be completed by July 1980, with the final SIPs due in July 1982 for those areas which will be getting an extension to 1987.[1]

Sanctions are included in the Act for failure to develop and implement adequate measures. Loss of some federal funds, including federal highway grants and stringent limitations on new development are among the sanctions included.

A cooperative planning process is emphasized in the Act. Such a process should include 1) interagency coordination, 2) participation of local elected officials and citizens, 3) public education among local, regional, state, and federal agencies, and 4) analysis of a broad range of alternative strategies. The transportation measure planning process and implementation should be integrated with the continuing, cooperative and comprehensive ("3C") transportation planning procedures set forth by the Department of Transportation. To encourage integrated planning further, the 1977 Clean Air Act indicated a preference for certification by State governors of the metropolitan planning agencies - already the DOT "3C" agencies - as the air quality planning organizations.

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[1] Information on the air quality status of individual urban areas is available from the EPA Regional Offices (see Appendix B).

Bicycle lanes, bicycle parking, and employer programs to encourage bicycling are among the reasonably available control measures (RACM) to reduce transportation pollution specifically mentioned in Section 108(f) of the Clean Air Act, as amended in 1977 (see Figure 1-1).

Many of the 1979 SIPs already received by EPA contain bicycle measures. States and urban areas including bicycle measures in their SIPs as of September 1979 are shown in Figure 1-2, and a more complete list summarizing the measures themselves is included in Appendix A.

Figure 1-1

Transportation Measures in the Clean Air Act, as Amended 1977

"(i) motor vehicle emission inspection and maintenance programs;

(ii) programs to control vapor emissions from fuel transfer and storage operations and operations using solvents;

(iii) programs for improved public transit;

(iv) programs to establish exclusive bus and carpool lanes and areawide carpool programs;

(v) programs to limit portions of road surfaces or certain sections of the metropolitan areas to the use of common carriers, both as to time and place;

(vi) programs for long-range transit improvements involving new transportation policies and transportation facilities or major changes in existing facilities;

(vii) programs to control on-street parking;

(viii) programs to construct new parking facilities and operate existing parking facilities for the purpose of park and ride lots and fringe parking;

(ix) programs to limit portions of road surfaces or certain sections of the metropolitan area to the use of nonmotorized vehicles or pedestrian use, both as to time and place;

(x) provisions for employer participation in programs to encourage carpooling, vanpooling, mass transit, bicycling, and walking;

(xi) programs for secure bicycle storage facilities and other facilities, including bicycle lanes, for the convenience and protection of bicyclists, in both public and private areas;

(xii) programs of staggered hours of work;

(xiii) programs to institute road user charges, tolls, or differential rates to discourage single occupancy automobile trips;

(xiv) programs to control extended idling of vehicles;

(xv) programs to reduce emissions by improvements in traffic flow;

(xvi) programs for the conversion of fleet vehicles to cleaner engines or fuels, or to otherwise control fleet vehicle operations;

(xvii) programs for retrofit of emission devices or controls on vehicles and engines, other than light duty vehicles, not subject to regulations under section 202 of title II of this Act; and

(xviii) programs to reduce motor vehicle emissions which are caused by extreme cold start conditions."

Source: Public Law 95-95 (H.R. 6161); Aug. 7, 1977, Clean Air Act Amendments of 1977. Section 108(f) amendments. Underlining added for programs specifically mentioning bicycles of nonmotorized vehicles.

Figure 1-2

Bicycle Measures in State Implementation Plans (SIPs)
as of September 1979

Region	State	Urban Area(s)
I	Mass.	Boston, Springfield
	N.Y.	Capital District/Catskill, Utica/Rome, Syracuse, Rochester, N.Y.C. metro area, Westchester County, Nassau County, Suffolk County
	N.J.	Atlantic City, Phillipsburg, Bergen, Essex, Hudson, Middlesex, Manmouth, Morris, Ocean, Passaic, Somerset, Union, Burlington, Camden, DVPRC/Mercer
III	Pa.	Allegheny County (Pittsburgh), Leigh & Northampton Counties (Allentown-Bethlehem-Easton), Scranton/ Wilkes-Barre, Harrisburg/Philadelphia/Pittsburgh
	Del.	Wilmington
	Md.	Baltimore, Howard County, Montgomery County, Rockville, Bowie, City of Gaithersburg
	D.C.	D.C.
	Va.	Northern Virginia Counties(including Arlington, Loundon, & Falls Church), Virginia Beach, Norfolk, S.E. Virginia, Portsmouth, Hampton City/Newport News
IV	Ala.	
	Ky.	Jefferson County
	Ga.	Atlanta
	S.C.	Charleston County, Columbia
	Fla.	Duval County, Jacksonville, Pinellas County, Broward County, Dade County, Palm Beach, Orange County
V	Ind.	South Bend
	Minn.	Duluth, Twin Cities, Rochester
	Ohio	Cincinnati, Kenton County (Ky.), Columbus, Cleveland, Canton
	Wisc.	Madison
	Ill.	Chicago
	Texas	Houston
	N. Mex.	Albuquerque
VI	Ark.	Little Rock
	Okla.	
VII	Kansas	Wichita
	Colo.	Denver
IX	Calif.	Los Angeles, San Diego, Montery/Santa Cruse, Santa Barbara, San Francisco
	Nev.	Las Vegas
X	Wash.	Vancouver, Seattle-Tacoma, Spokane
	Idaho	Boise
	Ore.	Salem, Eugene-Springfield, Ashland-Medford

Source: Nina Dougherty Rowe and EPA Bicycle Coordinators, Sept. 1979

1.2.2 Current Bicycle Use and Factors Affecting Levels of Use In Urban Areas

The primary purpose of bicycle strategies is to increase the number of trips and total vehicle miles ridden by bicycle rather than car. Because bicycle transportation is virtually non-polluting, each auto trip displaced will result in a direct positive impact on air quality through auto emission reduction.

Polluting emissions produced by the operation of automobiles include carbon monoxide (CO), hydrocarbons (HC), oxides of nitrogen (NO_x), particulates, lead, sulfates, and asbestos. In many urban areas, the automobile is responsible for well over 90% of CO emissions from all sources (6). Nationwide, approximately 40% of hydrocarbons and NO_x, about 9% of suspended particulates, and 3% of all sulfur oxides come from transportation sources (7). While many questions about the relationship between auto-related air pollutants and human health are not yet answered, a growing body of research implies that both short and long-term hazards to health (and property) are associated with levels of exposure experienced at some times in urbanized areas.

Carbon monoxide tends to be localized, peaking during rush hours when heavy traffic is encountered. Therefore, bicycle strategies to reduce this pollutant should concentrate on commuter travel, and travel in areas of heavy traffic such as to popular recreation facilities, shopping centers or schools. Other pollutants such as hydrocarbons and particulates are characterized by much greater dispersal over the urban area. Therefore, a bicycle strategy to reduce these pollutants could include programs to shift trips from auto to bike at a broader range of locations and times.

This section examines data on existing and potential bicycle use. The purpose of this summary is to provide a foundation for evaluating the potential impacts of the bicycle measures reviewed in Section 2.

Over the last 20 years, bicycle sales have increased approximately 250%, with 9.4 million bicycles sold in the U.S. in 1978 (8). In fact, during the six year span from 1972 to 1977, more bicycles were shipped and imported than cars (681 million bicycles to 601 million cars).

Because of the rapid increase in bicycle ownership during the 1970s, bicycles are accessible to many Americans. In fact, when estimated 1973/74 bicycle and automobile ownership levels in the U.S. and ten other industrialized nations are compared, the U.S. ranks fifth in bicycle ownership. (See Figure 1-3). Almost as many bikes were owned per 1000 population as cars in the U.S.

Figure 1-3

ESTIMATED LEVELS OF BICYCLE AND AUTOMOBILE OWNERSHIP IN ELEVEN COUNTRIES, 1973/74

Country	Bicycles/ 1000 inhabitants	Automobiles/ 1000 inhabitants
Denmark	596	242
Netherlands	590	249
Finland	522	200
Sweden	491	308
United States	430	482
Germany	419	275
Japan	382	145
Belgium	296	242
France	216	280
Italy	214	247
United Kingdom	202	248

Source: M. Taylor, "Pedestrians and Cyclists," 'Background Report #1, (OECD Road Research Secretariat: Paris, France) 1978.

In 1977, an estimated 46% of the American population used a bicycle at least once during the year (8). The estimated number of users has steadily increased over the years. For example, about 15% of the population used bicycles in 1950 and 26% in 1960 (see Figure 1-4).

Furthermore, the number and proportion of adult bicycle owners increased dramatically in the early 1970s. Adult bicycles constituted only 26% of all sales in 1968, but had increased to 58% by 1977 (see Figure 1-5). Many possible reasons have been advanced for increased interest by adults, including the introduction of the multi-speed, light weight bicycle into the U.S. during the late 1960s and early 1970s. The importance of aerobics and physical fitness was receiving widespread publicity during this period as well as environmental concerns. In addition, the OPEC oil embargo which occurred during 1973 and 1974, created gasoline shortages. Since the upsurge in adult sales began during this period, energy savings may also have been a reason for increased adult bicycle use.

While modal split data for bicycle travel have traditionally been neglected in transportation surveys, a few local surveys indicate that a substancial proportion of all trips are currently being made by bicycle in some localities with favorable conditions and bicycle programs. For example, 13% of all vehicle trips are made by bicycle in Madison, Wisconsin (9), an estimated 33% of all trips in Gainsville, Florida (10), and over 25% in Davis, California (11).

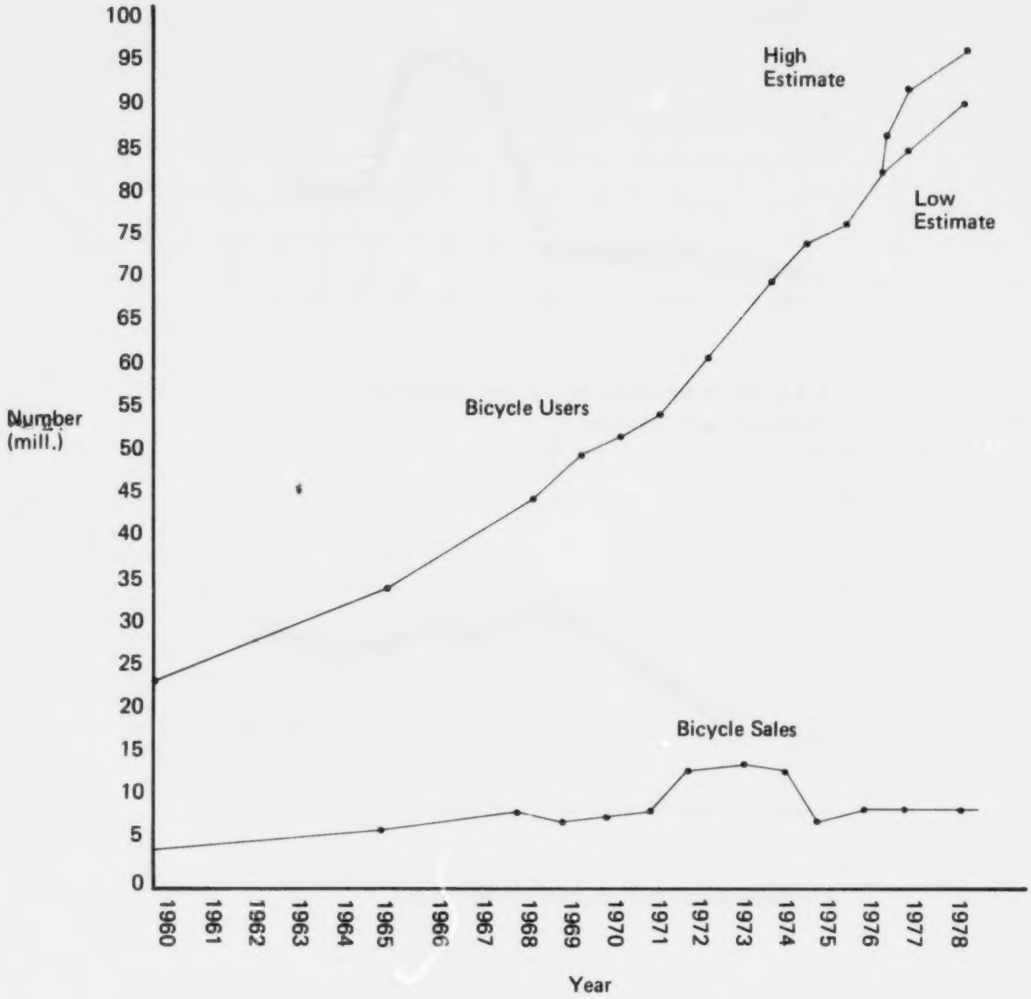
Despite the relatively high levels of use in some parts of the U.S., the potential of bicycle transportation is still relatively untapped compared with other industrialized nations. Developed countries in which the bicycle is an important means of transportation include many in Northern Europe. In the Netherlands, cycling is the most important transport mode (12) and virtually every family owns a bike. Forty percent of the adults use a bike every day, and 80% ride a bike occasionally (13).

Modal split (percentage of trips by transportation mode) data for all trips in 12 European cities are shown in Figure 1-6. Cycling as a percentage of all trips ranges from 5% in Marseille, France to 45% in Tilburg, Netherlands. Figure 1-7 indicates that the cycling modal split share for journey to work trips in a somewhat different set of 11 European cities ranges from 9 to 61%. In contrast, use of the bicycle as a major mode of transportation to work in the U.S. in 22 metropolitan areas ranged from negligible to 3.2%, with the average use for all workers .6% (see Figure A-2, Appendix A).[1]

---

[1] The American/European comparisons should be viewed as rough comparisons only. Most of the European cycling percentages include mopeds, thus overestimating bicycle use. The American journey-to-work figures may be underestimates since the major mode only is tabulated; in many areas bicyclists are likely to use their cycles only part of the year. Thus, the U.S. figures may underestimate the total percentage of trips made by bicycle.

Figure 1-4
ESTIMATED BIKES IN USE AND U.S. BICYCLE SALES

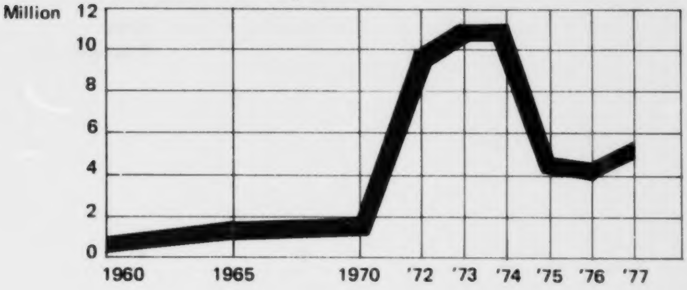


Source: Bicycle Manufacturers of America, Washington, D.C.

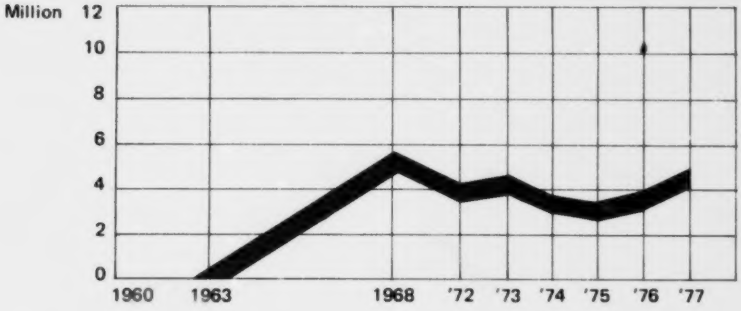
Note: Bicycles in use estimate is based on an estimate of bike "life" multiplied by a unit sales factor. Rental and other multiple use situations are calculated into the users estimate.

Figure 1-5
SALES OF ADULT VERSUS CHILDRENS' BIKES

USA LIGHTWEIGHT (ADULT) MARKET
Domestic and Imports



USA 20" (Childrens) BICYCLE MARKET
Domestic and Imports



Source: Bicycle Manufacturers of America

* Includes wheel sizes ranging from 24" to 27".

Figure 1-6

MODAL SPLITS FOR TWELVE CITIES IN EUROPE,
ALL TRIP PURPOSES

Country	City	Year	Percentage of trips by mode				
			Foot	Cycle	Private car	Public trans-port	Other (**)
Denmark	Copenhagen	1974	7	11*	34	48	
France	Grenoble	1973	40	14*	38	8	
	Lille	1976	38	12*	42	8	
	Lyon	1976	45	6*	38	11	
	Marseille	1976	52	5*	33	10	
	Nancy	1976	46	7*	36	11	
	Nice	1973	50	10*	33	7	
	Orleans	1976	35	15*	43	7	
	Rouen	1973	43	10*	41	6	
Netherlands	Tilburg	1972	26	45*	26	3	
	Zaanstad	1974	24	43	22	3	8
United Kingdom	Oxford	1976	---50---		23	27	

* Includes mopeds.

** Where given, otherwise FOOT + CYCLE + P.C. + P.T. = 100%

Source: M. Taylor, "Pedestrians and Cyclist," Background Report #1, (Paris, France, OECD Road Research Secretariat: Paris, France), 1078.

Figure 1-7

MODAL SPLITS FOR 10 CITIES IN EUROPE,
JOURNEY-TO-WORK

Country	European City or U.S. SMSAS	Year	Percentage of trips by mode				
			Foot	Cycle	Private Car	Public transport	Other**
France	Lille	1976	24	19*	49	8	
	Lyon	1976	23	9*	47	19	
	Marseille	1976	29	10*	45	16	
	Nancy	1976	23	11*	51	15	
	Orleans	1976	18	23*	50	9	
Germany	Bremen	1970	29	22	----49----		
Netherlands	Tilburg	1972	9	61*	28	2	
	Rotterdam	1971	20	22*	25	29	4
	Zaanstad	1974	10	40	37	2	11
United Kingdom	Stevenage	1976	19	9	50	20	

* Includes mopeds

** Where given, otherwise FOOT + CYCLE + P.C. + P.T. = 100%

DATA SOURCES: M. Taylor, "Pedestrians and Cyclists" Background Report No. 1, (Paris, France: OECD Road Research Secreteriat), 1978.

The extent to which U.S. bicycling could approach European levels is determined in part by factors shown in Figure 1-8. This figure summarizes factors identified during a literature search as associated with variation in bicycle use. Four major categories of factors are used: the physical environment, the social environment, other transportation alternatives, and individual population characteristics.

While the U.S. and Northern Europe probably vary somewhat on almost every one of the factors in Figure 1-8, the majority of the differences are not immutable. For example, gasoline prices are substantially higher in Europe making bicycling more attractive. However, recent increases in U.S. prices have begun to equalize these differences. Furthermore, despite somewhat more dispersed land use development in the U.S. than Europe, many U.S. auto trips are short enough to be taken by bicycle. The most recent[1] U.S. Nationwide Personal Transportation Study (NPTS) indicates that over half (62%) of all U.S. trips were five miles or less, accounting for 16% of all U.S. vehicle miles traveled (VMT) by car (14).

Survey data in the U.S. indicate most bicycle trips, excluding intermodal travel[2], are under five miles in length, regardless of trip purpose (see Figure A-3, Appendix A). The modal niche which bicycling currently occupies in the U.S. is indicated in Figure 1-9. Mean bicycle trip length is 1.4 miles for work trips (15), compared with 0.1 miles for walking and 9 miles or more for car/truck and transit.

The Physical Environment: The first factor identified in Figure 1-8 as affecting the rate of bicycle use is the size and density of the urban area--in other words, land use development patterns. Smaller, more densely developed areas are likely to have more short trips appropriate for bicycling. Development patterns probably account, in part, for the differences in mean automobile trip length among U.S. SMSAs. For example, workers in the Omaha and Providence SMSAs have average automobile trips of 5.8 miles and 6.0 miles respectively, compared to automobile trip lengths of 8.6 in the N.Y. SMSA and 9.9 in Baltimore.[3]

---

[1] Data from the 1978 NPTS is expected to be available during the latter half of 1979.

[2] Intermodal travel utilizes two or more modes of transportation to complete a trip, for instance, bicycle and bus.

[3] Selected Characteristics of Travel to Work in 20 Metropolitan Areas: 1976 (Washington, D.C.: U.S. Bureau of Census), September 1978.

Figure 1-8

FACTORS ASSOCIATED WITH BICYCLE USE

Physical Environment

- Size and density of urban areas affecting trip length
- Climate
- Terrain
- Hours of daylight
- Air Quality
- Safety Hazards
- Traffic Volumes
- Existing facilities for biking
- Aesthetics

Social Environment

- Social organization and use of time affecting trip purpose
- Crime
- Peer group support for bicycling

Other Transportation Alternatives

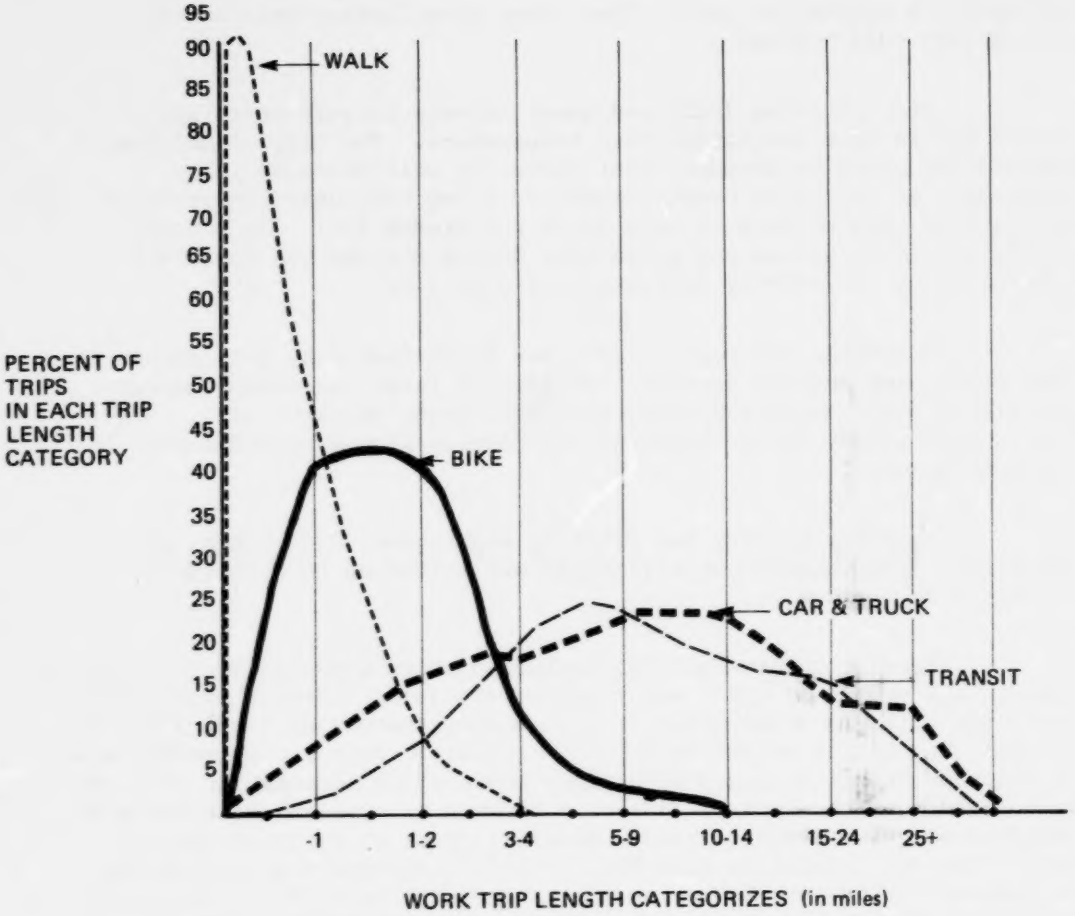
- Types
- Convenience
- Cost
- Comfort
- Safety
- Visibility

Individual Population Characteristics

- Income
- Age
- Bicycle riding skill level
- Physical condition
- Knowledge and perception of transportation options
- Trip mode preferences
- Valuation of time
- Valuation of exercise
- Fear of accidents

FIGURE 1-9

U.S. TRIP LENGTH DISTRIBUTIONS FOR WALKING, BICYCLE, CAR/TRUCK, AND TRANSIT WORK TRIPS



MEAN TRIP LENGTH		MEAN TRAVEL TIME
Bicycle	1.4 mile	12.1 minutes
Walk	.1 mile	8.7 minutes
Transit	9.1 mile	39.5 minutes
Car/Truck	9.0 mile	19.1 minutes
All Modes	8.5 mile	19.9 minutes

Source of Data: Bureau of the Census, **The Journey to Work in the United States; 1975,** Current Population Reports, P-23, No. 99 (Washington, D.C.: U.S. Dept. of Commerce), July 1979.

Several surveys on deterrent factors to increased bicycle use indicate bad weather influences the level of bicycle use in the U.S. (see Figure 1-10). A survey in Boston (16) indicated that bicycling activity falls off when the temperature is below 40°. However, winter temperatures among some northern European cities with high levels of bicycle use and many U.S. cities are surprisingly similar (see Figure A-4, Appendix A). Orhn (16) notes that "Even though weather conditions do affect or limit the use of bicycles, this may have been overemphasized somewhat, at least with respect to temperature." The Boston survey showed that at least 10% of the student cycling population uses their bikes 10 to 12 months per year, and 22% rode 7-9 months per year. Thus, many bicyclists continued to ride during cold weather.

Precipitation (rain and snow) affects bicycle operating safety and is more inhibiting than temperature. The City of Madison assumed for planning purposes that bicycling will decrease substantially on days with precipitation of a two hour duration or more, and when an inch or more of snow is on the ground (18). In Boston, rainfall of 0.10 within any given hour during the day was used as a cut-off point to estimate decrease in riding (16).

Nighttime was considered a deterrent factor by respondents in both Boston and Madison surveys. In fact, a large percentage of fatal overtaking motor vehicle/bicycle accidents occur at night (19). However, good bikeway design, lighting and bicycle lights should assist in reducing hazards.

Poor air quality was cited by Washington, D.C. bikers as a deterrent. (Information on effects of air pollution on cyclists is contained in Section 3).

Traffic safety hazards, including those associated with high speed, high volume traffic, are a major deterrent. Concern about accidents was cited as a deterrent in each survey summarized in Figure 1-10. Precise calculation of the extent to which bicyclists run a greater risk of death or injury compared with other modes of transportation is difficult because of the lack of data on accidents by type and location compared to bicycle miles traveled. However, State of Maryland data on total bike/car fatalities from 1973 to 1977 indicated that all of the 82 persons killed in bike/car accidents were cyclists (20). Everett's estimation of fatality risks for different transportation modes (see Figure A-5, Appendix A) also provides an indication of relative risk.

Figure 1-10

SURVEY DATA ON DETERRENT FACTORS

BOSTON, MASS.[1]		GAINSVILLE, FLA.[2]		STATE OF PA.[3]			WASHINGTON, D.C.[4]	
(Factor somewhat or greatly influential)		(Factor somewhat or greatly influential)		(Problem discouraging family members from using a bicycle)			(Problem areas most frequently cited by bikers)	
					Users	Non-Users		
Inclement weather	86%	Inclement weather	90%	Traffic, unsafe streets	7%*	3%	Necessity of bike paths	32%
Low temperatures	75%	Danger of Collision	73%	Not physically capable		3%	Need for bike racks	16%
Nighttime	69%	Hard to Carry Things	68%	Poor condition of bike	1%		Heavy Traffic	12%
Lack of Secure Parking Facilities	65%	Takes Too Long	45%	Bicyclists nuisance in st.		1%	Inconsiderate auto drivers	11%
Crime Areas You May Pass Through	64%	Hilly Terrain	43%	Fear of accidents, not safe	1%	1%	Inconsiderate bus drivers	5%
Danger of Auto Collision	53%	Too Tiring	25%	Hills	1%	1%	Smoke and exhaust fumes	7%
Condition of Pavement	52%	No Bike Rack at Destination	22%	Takes too long		1%	Hazardous road (bumps and storm drains)	7%
Availability of other Transportation	43%			No bike		1%	Need for education of motorists	6%
				Don't know how to ride		1%	Other	4%
				Fear of theft	1%			

*Percentages are of total sample population surveyed.
Many of those surveyed did not respond to the question.

DATA SOURCES: [1] Boston Area Bicycle Project (Boston, Mass.: Central Transportation Planning Staff), August 1, 1976

[2] B.T. Caine and R.L. Siegel, "The Second Most Frequent Mode of Transportation", Planning, Design, and Implementation of Bicycle and Pedestrian Facilities (New York, N.Y.: MAUDEP), New Orleans meeting proceedings, 1975.

[3] A.C. Nielsen Company, Survey on Bicycling Activity in the Commonwealth of Pennsylvania, (Minneapolis, Minn: conducted for the Pa. Dept. of Transportation by Barton-Aschman Associates, Inc.), November 1974.

[4] C.S. Shaw, "Citizen Participation in Bicycle Planning from the Public Agency's Viepoint", Transportation Research Record #570, The Bicycle As A Transportation Mode (Washington, D.C., Transportation Research Board), 1976.

(Figure 1-10, continued)

MADISON, WISCONSIN[5]

(Average ranking on scale of 1 - "not at all inhibiting" to 5 - "extremely inhibiting" for non-recreational bike trips)	
Danger of theft	2.75
Bad weather	2.63
Snowy	(4.43)
Raining	(4.02)
Cold	(3.40)
Windy	(2.68)
Heat	(2.06)
Personal Safety	2.61
Takes too long	2.32
Cannot carry packages	2.04
Lack of bicycle racks at destination	1.93
Too much physical effort and sweating	1.79
Too much starting and stopping	1.41
Social pressure (dress, ridicule, etc.)	1.30

MADISON, WISCONSIN[6]

(Average ranking on scale of 1 - "not at all dangerous" to 5 - "extremely dangerous" when riding bike)	
Riding in heavy traffic	4.32
Car turning abruptly	4.00
Car stopping abruptly	3.58
Car door opening	3.43
Cross traffic	3.43
Bad weather	3.40
Riding bicycle at night	3.32
Bicyclist making left hand turn	3.22
Railroad tracks	2.72

TEMPE, ARIZONA[7]

(Factors ranked as "most important" to inhibiting use of bicycles for everyday transportation)

	Users	Non-users
Danger from Auto Traffic	37%*	21%
Time	14%	16%
Weather	7%	3%
"Other"**	6%	21%
Fear of Theft	5%	3%
Physical Effort	3%	4%
Lack of Storage	2%	1%
Did not rank items	20%	17%
No answer	7%	14%

*Percentage of "most important" rankings.

**"Other" responses included: don't have a bike, distance/distance to work, bike in disrepair, don't want to/no interest, difficult to carry parcels, others.

DATA SOURCES: [5,6] Technical Memorandum III, Survey and Inventory, Findings and Implications, (Madison, Wisconsin: City of Madison), 1974.

[7] Tempe Bikeway Study: Background (Tempe, Arizona: Tempe Planning Department), September 1972.

Bicyclists in Washington, D.C. mentioned the absence of biking facilities as a deterrent (see Figure 1-10). Of the non-bikers surveyed in Madison, Wisconsin (21), 21% said they would ride a bicycle to work, 14% to school, 18% for shopping, and 49% for recreation if better facilities were provided.

A summary of bicycle riding incentive factors in Figure 1-11 indicates that 9% of those surveyed in Madison chose to ride a bike because of scenic or aesthetic factors.

The Social Environment: The second major category of factors associated with bicycle use in Figure 1-8 is the social environment. A major determinant of bicycle use is trip purpose, which is in turn related to the social environment (e.g., local economy, social organization, and use of time). Survey data on bicycle trip purpose is summarized in Figure 1-12. In some areas of the U.S., more trips are taken by bicycle for recreational purposes than other purposes, particularly when compared with the recreational percentage for auto travel. However, bicycle trip purpose is highly variable, with some areas such as Gainsville, Florida; Madison, Wisconsin; and Lakewood, Colorado, showing higher percentages of bicycle trips for school purposes. The major implication of Figure 1-12 is that bicycle trip purpose distribution (and by implication modal shift and emission reduction potential) is highly variable among individual localities.

Crime, including fear of bicycle theft and perhaps of personal assault, was cited as a deterrent factor (see Figure 1-10). Problems of personal security have been reported for bikers riding in isolated areas. Secure parking facilities and good lighting for night riding may reduce the impact of crime, and increase ridership.

One of the major differences between the U.S. and northern European environment is the traditional acceptance and use of the bicycle as an adult mode of transportation. However, this supportive environment does appear to exist in some university communities in the U.S., such as Davis and Madison, where existing levels of bicycle use are high.

Other Transportation Alternatives: The availability and use of other transportation alternatives, (category three in Figure 1-8) is probably a major determinant of bicycle use. For example, lower levels of bicycle use in the U.S. compared with Europe is probably partially related to higher level of automobile ownership in the U.S. than in the other 10 countries examined (see Figure 1-3). The extent to which increasing the attractiveness of bicycling will

Figure 1-11

SURVEY DATA ON INCENTIVES FOR BICYCLE USE

MADISON, WISCONSIN[1]

(Reason for choice of bicycle)	
Time	46%
Congestion	31%
Scenic	9%
Bike Route	3%
Other	11%

COLUMBUS, OHIO CBD STUDY[2]

(Reason for choice of bicycle)	
Parking Problems	30%
Quickest means of Travel	24%
Convenience	12%
Exercise	10%
Traffic Congestion	9%
Efficient Mode of Travel	8%
Economical	4%
Ease of Access to any Destination	2%

BOSTON, MASS.[3]

(Univ. student response on factors somewhat or greatly influencing bicycle use)	
Opportunity for physical exercise	80%
Saving money	41%

TEMPE, ARIZONA[4]

("most important" reasons for bicycling)	
Fun/recreation	37%
Exercise	30%
Economic reasons	12%
Transportation	9%
Environmental reasons	5%
Social reasons	4%
Other	3%

EUGENE, OREGON[5]

(reason for bicycling)	Total Sample	Non-Univ. only
Exercise	71%*	72%*
Bike is Quickest	51%	46%
It's Fun	49%	50%
Cheap Transportation	45%	46%
Environmental concerns	41%	40%
Only form of transportation	29%	27%
Convenient parking	18%	14%

*Multiple responses are reflected in percentages so column does not sum to 100%.

DATA SOURCES:

[1] Technical Memorandum I, Survey Procedures and Basic Summary (Madison, Wisconsin: City of Madison), 1974.

[2] J.M. Wright, "Pedestrian vs. Bicycle vs. Automobile - A Case Study", Planning, Design, and Implementation of Bicycle and Pedestrian Facilities (N.Y., N.Y., MAUDEP) New Orleans meeting, 1975.

[3] Boston Area Bicycle Project (Boston, Mass.: Central Transportation Planning Staff), August 1, 1976.

[4] Tempe Bikeway Study: Background (Tempe, Arizona: Tempe Planning Department), September 1972.

[5] Greenway Bike Bridge Evaluation Report - Phase I (Eugene, Oregon, Public Works Department) November 1978.

Figure 1-12

SHORT AUTO TRIP DISTRIBUTION BY PURPOSE COMPARED TO BICYCLE TRIP PURPOSE DISTRIBUTION

Trip Purpose	Automobile Travel[1] Trips	VMT	Bicycle Travel State of North Carolina[2]	Arizona[3]	Phil. CBD[4]	Gainsville, Florida[5]	Greenway, Oregon[6]	Lakewood, Colorado[7]	Madison, Wisconsin[8]	Wash., D.C. club members[9]	LAW[9]	State of Pa.[10]
Work	47%	39%	6%	3%	28%	16%	33%	6%	28%	(61%)*	(33%)*	6%
Utility	26%	22%	17%	11%	7%	13%	11%	18%	7%	21%	18%	18%
School[†]	11%	9%	2%	21%	40%	48%	10%	53%	40%	(61%)*	(33%)*	6%
Recreational and Social	16%	30%	75%	55%	19%	19%	37%	12%	25%	15%	34%	70%
Other					6%	4%	9%	5%		4%	16%**	

[†] E.g., personal business, shopping.

[††] School category also includes civic and religious trips.

[*] Work and school categories combined.

[**] Exercise is other category.

[1] Auto travel data is from the Nationwide Personal Transportation Study, Vol. 10 (U.S. Bureau of the Census, for the Federal Highway Administration, Washington, D.C.), November 1973.

[2] T.L. Huddleston , Bicycle Rider Characteristics in North Carolina (Raleigh, N.C.: Department of Transportation), August 10, 1977. Only purposeful trips (54% of all trips) were included.

[3] D.T. Smith, Jr., Safety and Locational Criteria for Bicycle Facilities, Final Report (DeLeuw, Cather & Company, for the Federal Highway Administration), October 1975.

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[8] Long Range Bikeway Program: A Summary Report of Proposed Policies and Facility Plans (Madison, Wisconsin: City of Madison), December 1975.

[9] J.A. Kaplan, Characteristics of the Regular Adult Bicycle User, PB-258-399, (Washington, D.C., Federal Highway Administration), July 1975.

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result in a modal shift from auto versus other transportation modes is not well documented. However, a survey in Pennsylvania in 1974 indicated that for all bicyclists, 58% would have otherwise reached their destination in a car, 33% as a driver and 25% as a passenger, if they couldn't travel by bicycle (see Figure 1-13). Only 3% would have used a bus or motorcycle. For bicyclists over 16, 62% would have driven a car, and 12% would have been an auto passenger. Forty percent of the bicyclists under 16 would have been an auto passenger, and 55% would have walked.

A survey in Washington, D.C. indicated a higher percentage of bicyclists would have walked if bicycles were not an option. Sixteen percent would have driven or been a passenger in a car for school trips, 40% for personal business, and 32% for work trips (see Figure 1-13).

After construction of a bicycle bridge in Eugene, Oregon, bicyclists using all three bridges in the city were surveyed. Twenty-nine percent of the bicycle riders surveyed said they used a car less frequently as a result of the bicycle bridge construction (22).

Individual Population Characteristics: The final category of bicycle use factors is individual population characteristics. These include income, age and physical condition, knowledge of and feelings about transportation options, valuation of time and exercise, and fear of accidents.

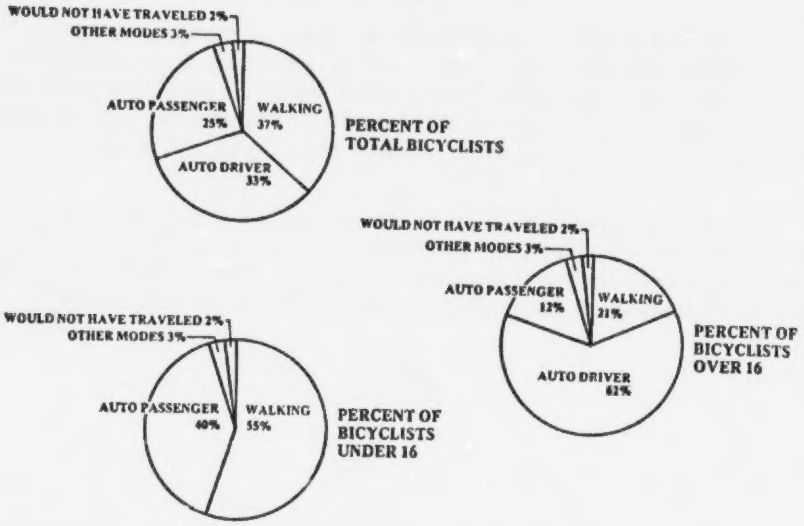
A statewide survey in Pennsylvania indicated that bicycle use is higher among higher income individuals (23) although the relationship appears to be reversed in areas with large university student populations (21,22). This may be partly a function of increased knowledge about options, since income is positively correlated with education. In addition, there may be more peer group support among higher income and university populations because of increased knowledge about air quality and other environmental problems.

Age is highly correlated with bicycle use, although local variations are apparent. A survey of bicycle use in the State of Pennsylvania shows almost all children between the ages of 12-15 using bicycles, but a substantial reduction in bicycle use for each higher age category (see Figure A-6, Appendix A). A somewhat different pattern is indicated in Madison, Wisconsin, which has a large university population (see Figure A-6, Appendix A). In Madison, the higher level of bicycle use is among the 25-44 age group. A similar pattern was encountered in an evaluation of bicycle users in another university community - Eugene, Oregon. Even when non-university riders were isolated, the highest levels of use were observed among those aged 16 to 34 years.

Figure 1-13

PRIMARY MODE OF TRAVEL FOR WHICH THE BICYCLE WAS SUBSTITUTED: STATE OF PA. AND WASHINGTON, D.C.

STATE OF PA.[1]



WASHINGTON, D.C.[2]

Trip Purpose	Walk	Auto Driver	Auto Passenger	Bus	Other	Total
To school	54%	8%	8%	29%	1%	100%
To personal business	29%	30%	10%	29%	2%	100%
To work	24%	24%	8%	44%	0%	100%

Sources: [1] Barton-Aschman Associates, Inc., Bicycling in Pennsylvania (for the Pa. Department of Transportation, Harrisburg, Pa.), May 1976.

[2] A.C. Nielsen Company, 1974 Survey of Bicycling in Washington, D.C. (under direction of Barton-Aschman Associates, Inc.), 1974.

Kaplan's study of League of American Wheelmen Members (24) indicated that accident involvement appeared to decrease as cycling experience and age increased. Furthermore, the oldest respondents (ages 66-82 years) traveled an average of more miles than any other age group. This data indicates the correlation between greater cycling skill and increased use of a bicycle.

Knowledge and perceptions of transportation options is felt to affect modal choice (25). Similarly, modal choice is affected by individual valuation of time (26), with equal length bicycle trips having different time costs to different individuals. Individual valuation of exercise will also affect the level of bicycle use (27).

Finally, some bicyclists have argued that the actual hazards of riding are not as great as perceived by some potential riders, assuming competent riding instruction (e.g., 28). They argue that removal of unnecessary fear will increase bicycle tripmaking.

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SECTION 2: BICYCLE PROGRAMS

2.0 Introduction

With an estimated 46% of Americans taking at least one trip a year by bicycle, and about 62% of all auto trips in the U.S. under 5 miles in length, more trips could be taken by bicycle rather than car if Americans are motivated to do so. Incentives and deterrents which affect such motivation were discussed in the previous section. This section contains descriptions of programs designed to remove deterrents and increase incentives to bicycling. Since virtually all the programs discussed in this section have been implemented somewhere in the U.S., the programs should be considered reasonably available control measures (RACMs) to control or reduce air pollution.

This section contains a summary of measures which can be combined into a comprehensive and mutually reinforcing program. Use of a single measure alone, such as provision of a single bike path or parking facility, will probably have little effect. Other complimentary measures are needed, such as engineering, safety education, enforcement, and encouragement.

Physical facility improvements for bicyclists are discussed under the engineering category. Bikeways, parking facilities, supporting facilities such as parallel grate replacement or traffic signals, and maintenance of facilities are examples of engineering measures.

The safety education category covers adult bicyclist training, instructor training, and police training. Juvenile bicycle safety education is also included, since some of the bicycle trips made by this age group substitute for trips in which the child would be driven by car.

Police training programs, assignment of special safety officers, bicycle peer courts, and bicycle registration are illustrations of enforcement measures currently in use in bicycle programs.

Finally, marketing and publicity activities which emphasize particularly enjoyable aspects of bicycling, such as exercise and money-saving benefits are summarized under the encouragement. Activities include employer incentive programs, media coverage, and bike maps.

2.1 Engineering

2.1.1 Bikeways

Bikeways are defined as routes used by bicyclists, including streets, highways, sidewalks, lanes and paths. Bikeways include routes shared with other transportation modes and exclusive routes.

One impediment to more widespread bicycle use appears to be fear of bike accidents (1). Motor vehicle collisions are particularly feared. Bicycle facilities may reduce fear of accidents and certain types of accident risk if well designed. The selection of the most effective mix of bikeway types for inclusion in a bicycle strategy will depend on a number of factors. These include local conditions, such as existing road conditions, trip purposes, demographic characteristics of riders, heavy trip corridors, and opportunities for bikeways. The types of bikeways discussed in this section are:

- use of best existing roads through bike maps
- wide roadway shoulders
- wide curb lanes
- bottleneck removal
- bikeway signs
- special roadway use signs
- bikelanes (shared & exclusive)
- separated bikepaths (shared & exclusive)

Detailed design standards for each type of bikeway will affect safety and use. Such standards have not been included in this document because there is a substantial literature setting forth standards and recommendations for bikeway design. One of the most recent bikeway standards is the CALTRANS Planning and Design Criteria for Bikeways in California (2). The Federal Highway Administration is currently revising the AASHTO Guide for Bicycle Routes (3). Other guides to standards include the Sorton et al. Pedestrian and Bicycle Considerations in Urban Areas (4), Forester's Cycling Transportation Engineering Handbook (5), and others (6,7).

Major advantages and disadvantages experienced by localities with each type of bikeway are summarized in Figure 2-1. Use of existing streets through development of a bicycle map is one of the least expensive techniques of improving the bicycling environment. Such maps can indicate which streets have low traffic volume or attractive scenery, and can be produced quickly. Urban areas producing bicycle maps include Boston, Denver, Washington, D.C. and Philadelphia. States preparing bicycle maps include North Carolina, Wisconsin, California, and Pennsylvania. A technical bulletin has been prepared by the Department of the Interior describing the North Carolina bike mapping process (8). An article outlining the process of bicycle mapping and sources of existing maps is contained in the first issue of Bicycle Forum (9).

Since such a large proportion of bicycle riding takes place on the street, one relatively easy way of providing more bicycle facilities is through institution of a policy of automatically providing a wide curb or outside lane, and/or a wide shoulder when road improvements or new construction takes place. As John Forester

Figure 2-1

ADVANTAGES AND DISADVANTAGES OF DIFFERENT BIKEWAY TYPES

Bikeway Type	Advantages	Disadvantages
Use of best existing roads through bike map	No capital investment needed, cost of bike maps only Can be implemented quickly	May not offer good protection against motor hazards for all riders Requires that map is widely available and used to select riding routes
Wide curb lane	Can be built and maintained as part of regular public works program	Possible conflicts with cars
Wide roadway shoulder	Can be built and maintained as part of regular public works program Use of freeway shoulders as in California can provide a safer route than arterial routes in some cases	May not offer adequate protection against motor vehicle encroachment May collect debris
Sidewalks	Low cost May be only alternative in some situations	May be associated with increased accidents (doubled in Palo Alto when tried) Intersection problems Conflicts with pedestrians may reduce speed, increase bike/pedestrian accidents In residential areas, smooth travel may be interrupted by children playing

Bikeway Type	Advantages	Disadvantages
Signing	Low cost May make motorists more cautious	May give false sense of security to rider because signs may be ignored by vehicle driver
Special use signs (bike use during specified times)	Low cost Motorists generally respected signs and bicycles in D.C. and Seattle	May slow auto traffic May not be obeyed in heavy traffic and speeds over 40 mph (e.g. in Washington, D.C.)
Bikelanes shared with parked cars	Low cost	Bicyclists subject to serious injury from opening car doors, cars driving across bike lane to park (problem in Palo Alto)
Exclusive bikelanes on the roadway	Desired by many bikers Maintenance easy (except where curb barriers used) Generally easy to implement Low Cost Motor vehicle/bike accidents decrease over on-road riding Bicyclist behavior generally more predictable for motorists	Regular sweeping needed Regular painting of lane needed Davis survey indicates increase in accidents associated with bicyclist left turn (bicyclist has to cross traffic if not using pedestrian walk pattern)

Bikeway Type	Advantages	Disadvantages
Separate bike path shared with pedestrians	Politically feasible in areas where cost of exclusive bike path too high, or land not available for two paths Works well in areas with low density, low speed bike traffic and few pedestrians Best-liked and most heavily traveled in D.C.	High speed bike travel and pedestrians incompatible High cost construction, separate maintenance from roadway required Increased accident rates associated with motorist right hand turn at intersection Right-of-way not always available
Exclusive bike path	maintained and well designed (e.g., wide enough), offers good riding experience Removed from noise, air pollution	Expensive Security problems experienced in some areas not visible from road (e.g. Eugene, Orono, Niles) Increased accident rates associated with motorist right hand turn at intersection

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Note: Some portions of figure draw on work by David Pelz, Davis, Ca.

points out, a 14-16 foot roadway width (instead of the usual 11-12 ft.) "does not divert highway funds to non-highway projects, but neither does it kick cyclists off the roadway .... It requires no new financing modes and no new laws" (10). The transportation and public works agencies already have funding mechanisms in place to assist in routinely providing wide shoulders. Such an effort is currently underway in Dane County, Wisconsin, to serve the Madison metropolitan area. Over 50 miles of shoulder have recently been widened with highway funds (11).

Sidewalks may be an alternative for novice or juvenile bikers in some urban situations with narrow roadways and heavy high speed traffic. This is a relatively inexpensive method, only requiring curb cuts at intersections and possible signing. Massachusetts, for example, rescinded its state law prohibiting sidewalk riding. Concern has been expressed over increased intersection and driveway accident hazards, particularly since Palo Alto experienced a major increase in accidents when they included sidewalks as part of a bikeway system. Insufficient data are available to determine the extent to which the accident increase occurred because of an increase in bicycle riders (increased exposure). A new study of bicycle/pedestrian conflicts on shared pathways concludes that a mix can only be successful in very low volume conditions (12).

Special bike signs on the streets were the last preference of bicyclists in a Washington, D.C. survey (13), and regular bike signs were the next to last choice. One report suggests that signs generally give the illusion of providing facilities but may serve as a temporizing device by officials not willing to fully support bicycling measures (14).

Special signs may provide some added protection for bicyclists. For example, signs in Seattle require that motor vehicles yield to bicycles and D.C. signs state "Change Lanes to Pass Bicycles" during rush hours giving the bicyclist the entire lane. In Washington, D.C. such signs were often not obeyed when traffic was heavy and speeds exceeded 40 mph. An evaluation (13) concluded that special signs should be used on streets with slower traffic.

The only real advantages of bike route signs are a possible increase in motorist awareness of bicycle traffic, provision of directional information (if included on the sign), and information that the signed route may be safer in some way (e.g., have been selected because of a low traffic volume or wide street width). It is also important to remember that bicyclists will rarely travel more than a block or two out of their way for bike routes except for recreational purposes. Palo Alto, for example, installed signs along 27 miles of streets (15% of the city street system), only to find a year later that over 65% of the bicyclists surveyed said they "never" or "seldom" used the bike routes.

Bikelanes and separate bikepaths were the most popular types of bikeways in the survey of Washington bicyclists. Bikelanes have the advantage of relatively easy implementation at low cost. A survey in Davis, California (15) concluded that bike lanes improved riding conditions for riders using the same route with and without bike lanes. Other detailed comments included increased safety carrying children on bikes, removal of the hazard associated with opening car doors, increased safety for youngsters, and slowing of auto traffic through removal of a traffic lane.

Universities provide some of the best examples of bike paths. For example, exclusive paths have been established at the Boulder campus of the University of Colorado. Due to the high concentration of bicyclists and pedestrians on this campus, university planners decided to separate the two groups. The Davis campus of the University of California provides "bicycle streets" within the campus. These are regular streets which have been closed off to cars by installation of bollards[1] closing the street at the entrance to the campus.

Intersection hazards have been a particular problem for riders on some bikepaths, particularly conflicts with right-turning motor vehicles who are unaware of a bicycle path entering the roadway because they cannot see the path. In addition, objections have been voiced by many bicyclists to mandatory use of bicycle paths. (This issue is discussed further in Section 4.1.2.). Other criticisms of some existing paths include inadequate design (e.g. poor sight distance, abrupt curves, inadequate width), and inadequate maintenance.

2.1.2 Maintenance

Poor maintenance resulting in potholes, broken glass, sand, and other debris is a major deterrent to increased bicycle riding. Maintenance problems can cause severe accidents and make riding generally unpleasant. Further, localities have been sued for accidents caused by inadequate maintenance. Separated bikepaths need particular maintenance attention, since they are not swept clean by cars or street-cleaning equipment as in the case of some other bikeways. Lawsuits and lack of use have resulted in some areas without good maintenance of bikepaths. Therefore, a comprehensive bicycle strategy should contain clear assignment of responsibility for regular inspection, street sweeping, bikeway sweeping, and tree trimming by local governments and an adequate budget.

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[1] A bollard is a post installed in the roadway, preventing motor vehicles from passing through.

2.1.3 Supporting Facilities

Supporting facilities may include removal of parallel grates along bicycle routes, installation of bicycle-activated traffic signals, lighting for routes used at night, opening of bridges or expressways when safer than the alternative routes, and barrier or bottleneck removal.

Drainage grates are a major hazard if they are the parallel type with spaces between the bars of more than 3/4". This grate type is the most widely used because it channelizes water effectively and does not get stopped up easily with leaves and debris. Therefore, it is reportedly more effective for drainage than some alternatives in preventing flooding in areas with heavy surface runoff. Nevertheless, many bicyclists have been injured when their bicycle tire caught between the parallel bars. Replacements are available including the honeycomb, criss-cross, or "E" grates. Steel straps can also be welded onto existing parallel grates. A detailed study on the hydraulic characteristics of bicycle-safe grates has recently been completed under U.S. Department of Transportation sponsorship (16). Characteristics of grates on both continuous grades and in sump conditions were tested. This study should be consulted when selecting the most appropriate grate for a given condition.

Towns are well advised to install bicycle-proof grates on routes traveled by bicyclists before an accident occurs and the town has to pay not only the damage awards but replace the grates as well. Exactly such a lawsuit took place in the Boston area when a bicycle wheel caught in a parallel grate, the rider broke a wrist, and collected damages from the town. The town was also ordered to replace the grates.

A large proportion of bicycle accidents occur at intersections. Therefore, intersections should be carefully designed and consideration given to installation of bicycle-actuated traffic signals at difficult intersections. Signals include magnetic induction loops and hand-actuated push buttons. The induction loops which automatically detect bicycle are in operation in both Cupertino and Davis, California. Also, in Denver, standard push button actuated pedestrian signals have been placed adjacent to some bikeways. This readily available equipment allows plenty of crossing time but its use by bicyclists depends on how conveniently the buttons are located.

Lighting and edge striping may be particularly important along separated bicycle paths which have heavy use after dark.

Barrier or bottleneck elimination is also important. A partial list of barriers or bottlenecks and possible solutions includes:

Barriers	Possible Solutions
Road discontinuity or bottlenecks between neighborhoods	Construct bikeway link
Heavy traffic corridor	Construct bikeway link or indicate alternative route
Bike route discontinuity	Construct bikeway link (e.g., wider curb lane or shoulder)
Poor road condition	Resurface and maintain
Heavy cross traffic	Install bicycle-activated signal
River, canal, freeway	Construct bridge, overpass
Railroad tracks	Construct overpass or perpendicular crossing
Limited access bridge	Change policy, or institute shuttle or bus bike racks
Tunnel	Indicate by-pass route, institute shuttle
Expressway	Open to bikes if safer than alternative routes

Eugene, Oregon and the State of California provide examples of bicycle barriers removal. In Eugene, a river barrier was removed when U.S. Department of Transportation demonstration funds were approved for construction of a bicycle bridge. Surveys of bridge users indicate that travel time has been reduced by 62% on average, 50% of the riders using the bridge are new riders, and 29% of the riders switched from car to bike (17).

In California, bicyclists noted that expressways were an important but closed link in local bicycle networks. For example, the president of the Santa Clara Valley Bicycle Association noted in the case of closed expressways, "many times the alternative route is confusing, unsafe, and extra miles out of the way" (18). Under the direction of Dick Rogers in California's Office of Bicycle Facilities, a result, approximately 230 additional miles of freeway shoulder were opened for bicycle use in 1978.

2.1.4 Intermodal Links[1]

Bicycle strategies to reduce air pollution can be more effective if intermodal links are provided. Dual-use facilities include provision for parking at transit stations and for transporting bicycles on cars, buses, trains and boats. Intermodal links serve an important function in bicycle strategies because they can permit bicycle travel to be used as part of long trips.

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[1] An intermodal link is a facility (e.g. bike parking rack at a station, bus rack) permitting a bicycle to be used for a portion of a trip and another mode of transportation such as train, bus, or car to be used for the other portion of the trip.

The bicycle can be used as a feeder mode for transit if secure parking is provided. Either racks or lockers can be used, although lockers are probably more appealing to regular commuters because of their added protection against theft, vandalism, and weather. Such lockers have been installed at a number of transit stops in the BART system in San Francisco, Washington, D.C.'s METRO system, Atlanta's MARTA system, and at park-and-ride lots in the Baltimore area. The Baltimore experience illustrates the importance of surveying demand before installing lockers and of publicizing bicycle parking availability. The park-and-ride lockers were not used in some locations and eventually were relocated to university parking areas where demand existed (19). Conversely, in Palo Alto, the locker units at the train station have never been vacant during the four years since installation (20). Regular commuters rent the lockers for $5 per month; the on-demand coin operations were discontinued because of vandalism.

Bikes can already be taken on to some ferries and trains. For example, New York and San Francisco provide ferryboat service to commuters and permit passengers to bring bicycles on board. The BART (Bay Area Rapid Transit) system in San Francisco permits bicycles on board its cars during off-peak hours, as does the PATH system in New York and New Jersey. The London subway system also carries bicycles. However, transporting bicycles on trains has been resisted by railroads in many areas. For example, the Boston commuter railroad refuses to permit bicycles on board, stating bicycle loading would result in schedule slow-down and subsequent passenger loss.

Several bus/bicycle demonstrations provide information on the feasibility of bus trailers and carrying bicycles inside busses. Bus trailers have been tried by Santa Barbara and the San Diego Transit Authority. In Santa Barbara, a 14-bicycle trailer towed behind a conventional bus connected the University of California at Santa Barbara with the downtown area. San Diego operated a similar service across the San Diego-Coronado Bay Bridge from April 1975 to June 1976. Both services have been discontinued because of the continuing subsidies required. A pedal-hopper, a bus interior redesigned to accomodate 24 bicycles and riders, was tried in San Francisco. Connecting Oakland with San Francisco, this service was also discontinued because of costs. In contrast, bus-bike service has been provided through the Purfleet Tunnel in England for about 20 years (21).

Because the bicycle/trailer demonstration in San Diego showed that demand existed for a bicycle/bridge service, CALTRANS examined lower-cost alternatives. The major cost of the previous demonstration was driver wages for the exclusive bicycle service, so the new experiment added a bicycle rack on the back on busses already making the trip. San Diego Transit provided busses, maintenance and administration; CALTRANS provided four bicycle racks capable of holding five bicycles each at a cost of $1000 per rack.

Total maintenance expenses during the nine month period monitored were $2538, and operating revenues from both the rack fees and bicyclists' bus fares were only $1236. Operating deficits were experienced due to the coin box which was part of the bicycle rack locking system. Road dust jammed the coin boxes, requiring labor-intensive cleaning of the boxes every few days. Aside from this problem, CALTRANS concluded that the bus rack system did not cause operating delays, that racks were less expensive to operate than vans, and that the operating loss associated coin box cleaning could be reversed by providing free bicycle rack service. Free service could also increase bus patronage among bicycle riders, with the increased passenger fares offsetting the capital cost of the bicycle racks (22).

Bicycle racks are being provided on special bus service in Seattle. The "Seattle Parks Special" services, a loop route including downtown, 10 parks, the aquarium and historic sites in Seattle were provided on weekends and holidays during the summer of 1979 (23).

Car/bicycle trips are common for recreation and offer potential for work trips. Uncertain weather would not be as much of a deterrent to bicycle commuters if they knew they could get a ride home by car if rain or snow developed during the day. The existing car-pooling system could be used to provide information on such potential auto transportation. Employer provision of a bicycle rack to be loaned out overnight might increase the use of a car/bicycle pool program.

Vans with bicycle parking trailers have been sponsored by CALTRANS for San Diego bicycle commuters. Bicyclists travel to a designated location where they meet the 12-passenger van for the journey to work.

2.1.5 Parking and Storage

A network of bikeways and intermodal links should be complemented by secure bicycle parking facilities at major activity centers, such as public and private employment locations, transit stations, schools, shopping centers, recreation areas, and municipal facilities. Without parking facilities, cyclists are forced to chain their bikes to poles, trees or similar available objects, often creating pedestrian barriers, or running the risk of having their bike stolen.

To illustrate the theft problem, over 600,000 bicycles were stolen in 1977 in the 12 most populated states, representing a loss of over 21 million dollars (see Figure 2-2). In North Carolina alone, there are approximately 29 bicycles stolen every 24 hours, which represented a loss of over $1 million per year between 1975 to 1977. A bike rack provides some protection against theft when used with a well-constructed, theft resistant padlock. Many different types of locks and racks are now available, with descriptions and costs of some types included in Appendix C. Bike racks will provide more of an incentive to new riders if the racks are located close to the entrance of work places or in a central location for shopping. Placement of the racks under cover is an added incentive. The standard pipe bike rack which merely holds the bike upright is not adequate for locking both wheels and the frame. Bike lockers and use of bike parking storage rooms provide the most secure environment. Interior space, if available, also may be a solution. Lockers are in use in many federal locations currently, including the Department of Health, Education and Welfare and the Environmental Protection Administration offices in Washington, D.C. Lockers are more expensive than racks, however, and may not be necessary or feasible in many situations.

2.2 Safety Education

Two types of safety education are discussed in this section. Adult education is most immediately related to air quality improvement, since trip diversion from auto to bicycle trips will take place among adult drivers. Juvenile education should not be ignored in a bicycle strategy, however, since children will be making the choices in the future about bicycle and auto use. Furthermore, if parents perceive the bicycling environment is safe or safer for their children, the adults may be more likely to use a bike more often themselves, or permit children to make a trip by bike rather than in a car driven by an adult.

Hundreds of films, pamphlets, teacher training guides and other bicycle education materials and techniques have been produced for all age groups from pre-school children to adults. Under the sponsorship of the U.S. Department of Transportation and the U.S. Consumer Product Safety Commission, many of these materials were catalogued and annotated in a publication titled 1977 Bicycle Safety Education: A Guide to Resources and Materials (24). Unfortunately, few of these materials have been evaluated for accuracy of information, or for effectiveness of presentation as measured by short and

Figure 2-2

1977 BICYCLE THEFT STATISTICS FOR THE 12 MOST POPULATED STATES

States	Offenses Per Thousand Population	Offenses	Value
Florida	4.4	37,365	$3,176,776
New Jersey	4.3	32,205	$3,195,394
California	4.0	38,022	$6,040,459
Illinois	3.5	40,143	$ 285,792
New York	3.0	55,178	$2,851,135
Ohio	2.7	29,777	$ 285,792
Texas	2.6	34,509	$2,181,642
Pennsylvania	1.9	22,594	$3,365,298
North Carolina	1.9	10,603	$1,032,727
Indiana	*	*	*
Michigan	*	*	*
Massachusetts	*	*	*

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*Not Available

Source: Michael Connelly & Elizabeth Hofton, North Carolina Bicycle Registration Study (Research Triangle Park, N.C.: RTI for the N.C. Bicycle Program) November 15, 1978.

long term information retention, behavioral changes, or reduction in accidents. A recent DOT-sponsored bicycle safety project report concluded: "The state of the art in safety education is to implement a program with no effectiveness measures and use unprofessional measurement techniques to infer success for the program" (25).

One of the problems plaguing the design and evaluation of bicycle safety programs has been insufficient knowledge about which accident situations are most common and hazardous. A major study of Dr. K. Cross in 1975 (26) provided reliable data on bicycle/motor vehicle accidents through a detailed study of almost a thousand accidents in four different sampling areas. Seven generic and 25 subtypes of accidents were identified which account for over 85% of reported fatal accidents and 90% of reported injuries in the sample. A summary of the generic categories and associated accidents is contained in Figure 2-3.

Based on this work, Dr. Cross has developed recommendations by age group for educational programs and other measures which could be taken to increase safety (27). For example, in the accident type where bicyclists make unexpected left turns across traffic, in 94% of the cases the bicyclist did not check thoroughly to see if a car was approaching. Education programs directed to this problem should therefore stress thorough search procedures by cyclists. Air quality planners and others interested in increasing bicycle safety should encourage localities to consider the findings of Dr. Cross.

2.2.1 Adult Education

Reaching adults with educational programs, especially in numbers large enough to make a significant difference in safety improvement, has been difficult. The mass media (e.g. TV, radio) offer some potential, and are being tested in a public awareness demonstration in North Carolina. Developed through the state's Bicycle Program, the awareness campaign is developing a safety campaign utilizing TV, radio, newspaper, and posters. Hazard recognition, emergency manuvers, and bicyclist vulnerability are among the messages. An analysis of the effectiveness of the awareness campaign is also planned.

Since the majority of teenagers take a motor vehicle driving test, several states have included information on bicycles in their driver education handbook. Applicants for licenses are required to read and remember this material in order to pass the written test, so presumably bicycle-related material is memorized. An example of such material from the Massachusetts Drivers License Manual is shown in Figure 2-4.

Several "hands-on" education programs for adults have been initiated recently. For example, the League of American Wheelmen provides instruction and certification to bicycling instructors, and awards certificates to successful students of their Effective Cycling Program. Based on a training program developed by J. Forester, the Effective Cycling Instructor's Manual (28) is used as a text

Figure 2-3

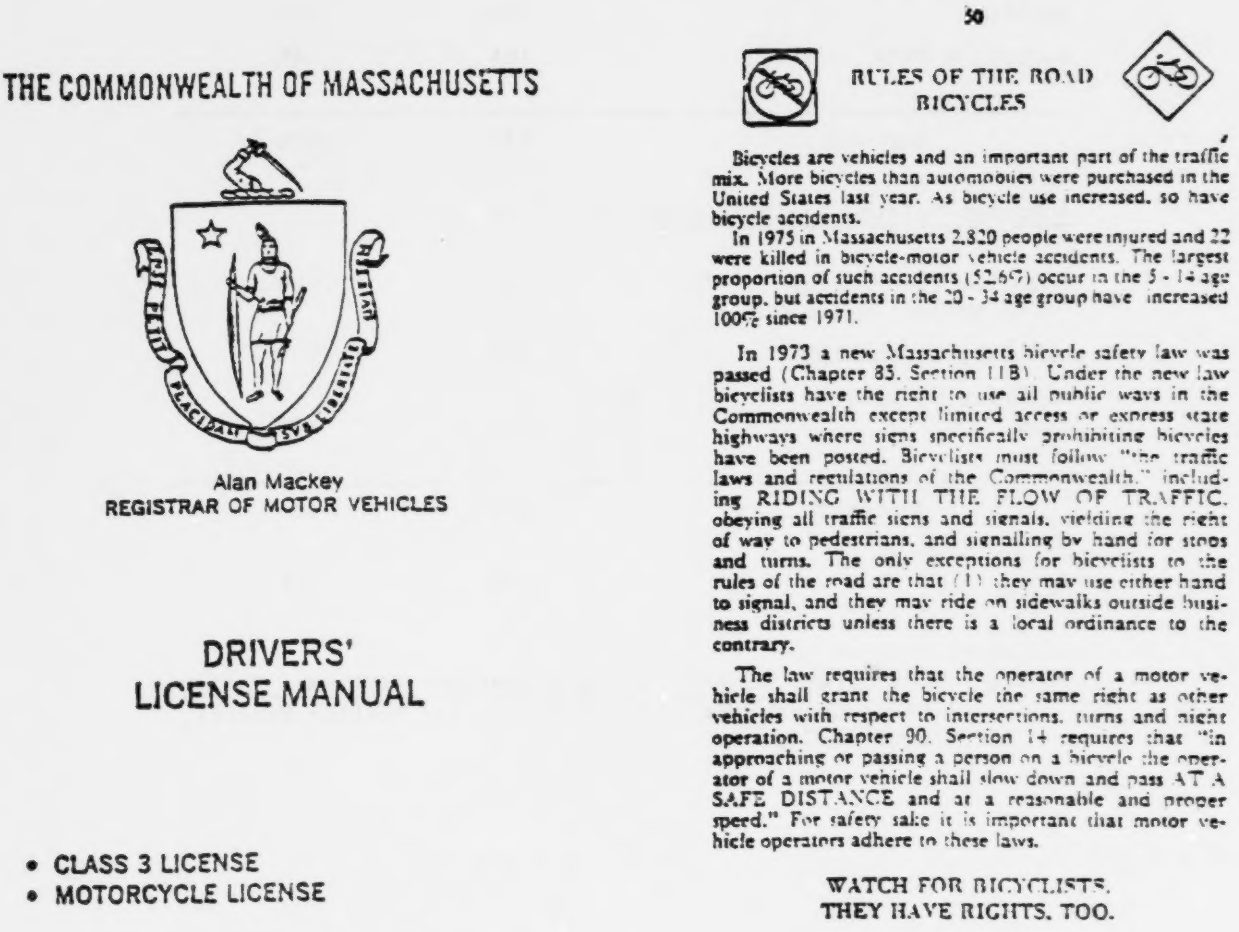
CATEGORIZATION OF BICYCLE/MOTOR VEHICLE ACCIDENTS

Bicycle-Related Accident Type	Fatal	Non-Fatal
Bicycle Rideout: Midblock	15%	14%
Bicycle Rideout: Intersection	12%	17%
Bicyclist Turn	16%	14%
Subtotal:	43%	45%
Motorist-Related Accident Type		
Motorist Turn/Merge/ Drive Through/Drive Out	2%	19%
Motorist Overtaking	38%	10%
Motorist Unexpected Turn	2%	14%
Subtotal:	43%	44%
Other	14%	11%

Source: K.D. Cross, Bicycle Safety Education--Facts and Issues (Falls Church, Va. AAA Foundation for Traffic Safety) August 1978.

Figure 2-4

BICYCLE INFORMATION IN DRIVERS' MANUAL



THE COMMONWEALTH OF MASSACHUSETTS

Alan Mackey
REGISTRAR OF MOTOR VEHICLES

DRIVERS'
LICENSE MANUAL

- CLASS 3 LICENSE
- MOTORCYCLE LICENSE

50

RULES OF THE ROAD
BICYCLES

Bicycles are vehicles and an important part of the traffic mix. More bicycles than automobiles were purchased in the United States last year. As bicycle use increased, so have bicycle accidents.

In 1975 in Massachusetts 2,820 people were injured and 22 were killed in bicycle-motor vehicle accidents. The largest proportion of such accidents (52.6%) occur in the 5 - 14 age group, but accidents in the 20 - 34 age group have increased 100% since 1971.

In 1973 a new Massachusetts bicycle safety law was passed (Chapter 85, Section 11B). Under the new law bicyclists have the right to use all public ways in the Commonwealth except limited access or express state highways where signs specifically prohibiting bicycles have been posted. Bicyclists must follow "the traffic laws and regulations of the Commonwealth," including RIDING WITH THE FLOW OF TRAFFIC, obeying all traffic signs and signals, yielding the right of way to pedestrians, and signalling by hand for stops and turns. The only exceptions for bicyclists to the rules of the road are that (1) they may use either hand to signal, and they may ride on sidewalks outside business districts unless there is a local ordinance to the contrary.

The law requires that the operator of a motor vehicle shall grant the bicycle the same right as other vehicles with respect to intersections, turns and night operation. Chapter 90, Section 14 requires that "in approaching or passing a person on a bicycle the operator of a motor vehicle shall slow down and pass AT A SAFE DISTANCE and at a reasonable and proper speed." For safety sake it is important that motor vehicle operators adhere to these laws.

WATCH FOR BICYCLISTS.
THEY HAVE RIGHTS, TOO.

Reproduced from
best available copy.

for instructors and Effective Cycling (29) for the adult students. The course consists of a minimum of 30 hours of instruction, 20 on the road and 10 in the classroom (30). Objectives of the training include increased confidence in on-road riding, as well as simple skill improvement.

In Michigan, an education program for community leaders, such as judges and police, has been initiated at the state level under the direction of Bonita Neff and the 4-H (31). This program includes long bicycle trips so that influential officials and staff are directly confronted with actual problems facing bicycle riders in their area.

2.2.2 Juvenile Education

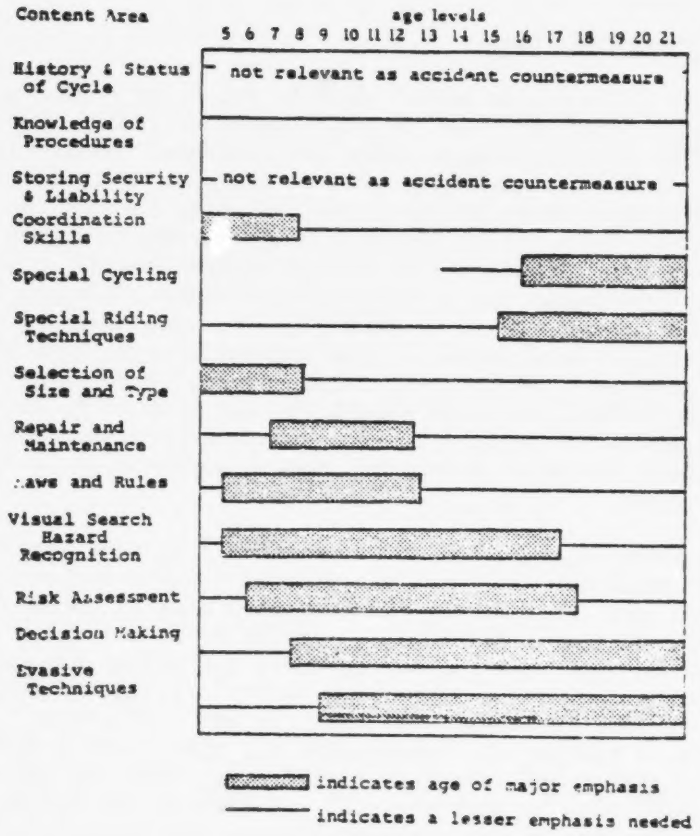
As of 1977, public school bicycle safety education programs were available through at least 30 state agencies (24). Many local school districts have developed their own programs. Santa Clara City, California, and Newton, Massachusetts are examples of localities which have developed their own programs including on-the-road practice. The Santa Clara City Elementary School Cycling Program includes bicycle inspection, classroom instruction through movies or a lecture and road training. The items covered include riding on the right-hand side, right turns, traffic signals, stop signs, pedestrian-style left turns on major streets, and vehicular-style left turns on residential streets. The on-road training takes place in groups of less than six children. A high school cyclist trained by the local cycling club and a PTA cycling parent provide supervision. Instruction takes place during an afternoon, and is expected to be reviewed periodically (30).

The program in Newton developed over a 22 year period. Initially, a rodeo was used, but was dropped because the less-than-superior rider was not rewarded and simulated streets encouraged inadequate hazard search techniques. Groups of no more than 15 are now taken for on-road training during their gym class. The group is instructed by the police department safety officer who rides in a car and uses loud speakers. The children are accompanied by three parents, a teacher who accompanies all rides, and a bicycle teacher. Generally, the school principal rides with the safety officer at least once to lend official sanction to the instruction. The group remains out on the road until right and left turns, and hazard recognition appear adequate for each member of the group, including the adults. Some principals require that children participate in and successfully complete this training before they ride their bikes to school (32).

Under the direction of Donald LaFond, the State of Maryland provides one of the few examples of an educational program based on analysis of local accidents and testing for recall of the bicycle safety material presented to students. The content of film strips prepared for use in local schools is based on concepts relating to known accident types associated with various age levels. The content areas by age level are shown in Figure 2-5.

Figure 2-5

MAJOR EMPHASIS OF BICYCLE EDUCATION CONTENT BY AGE LEVEL



Source: D. LaFond, State of Maryland as illustrated in Regional Workshops on Bicycle Safety: Presentations, Participant Problems, Programs and Ideas and Recommendations, V. S. Darago (Urban Scientific and Education Research, Inc. for the NHTSA, Wash., D.C.), September 1978.

Film strips provide the core technique used in the Maryland program. The director feels a wider range of hazard situations can be presented through use of film than would be possible or safe in an on-road training situation.

Learning and retention in the Maryland program were evaluated in a sample of 7th, 8th, and 11th graders at 10 schools. Based on a pre- and post-viewing test, immediate retention was close to 90%. Eight to nine weeks later, recall was about 86% and was still close to 80% three months later (33).

Other new programs include a multi-grade (K-12) National Bicyclist Training Program which is currently being developed by the Bicycle Federation, under the direction of Katie Moran. The program will include on road training, with a pilot test planned in the Denver area. The program will also include modules for adults, and will result in certification of course participants. (34)

2.3 Enforcement

The data on aggressive enforcement programs indicate that such programs--when combined with policy education in schools, are about as effective in reducing accidents as well-designed bikeways. Since the perception of accident risks on bicycles is cited in surveys as a major deterrent to increased use, reduction of accidents through enforcement of safer bike riding habits may increase ridership over time.

A review of bicycle enforcement programs (35) concludes that most of the programs are similar. (Programs in North Carolina; the State of Wisconsin; Tennessee; Boulder Valley; Des Moines, (Iowa): Santa Barbara,(Ca.); Concord, (Ca.); and Richfield, (Minn.) were among those reviewed.) All the enforcement programs attempt to involve the community in the program. Peer courts using community members as judges, and high school or college-age bicycle patrols who ticket bicycle traffic offenders are among the techniques used to increase community participation.

The Concord, California program uses a three student bicycle court for juvenile offenders. With more than 1,000 cases handled annually, the success rate has been remarkable with only 3% repeaters over a five year test period. (36).

Other effective enforcement programs include those in Des Plaines and Niles, Illinois. The City of Des Plaines organized a bicycle program in July, 1972, with a police officer spending the majority of his time giving safety lectures in all grammar schools, conducting bicycle rodeos, supervising the bicycle court, and issuing warnings and tickets to violators. While a popular program, accidents continued to increase, as shown below.

Year	Accidents	Warnings	Tickets
1972	41	39	0
1973	27	73	116
1974	33	46	237
1975	69	61	343

Data Source: Des Moines Police Department

As a result, Des Plaines decided to adopt the more aggressive bicycle enforcement warden system used by the neighboring town of Niles. In this program during 1975, Niles wardens stopped 6,000 cyclists, issuing warnings and instructing cyclists in proper bicycling techniques. As a result, their accidents went from 17 to 3. (37). The similarly encouraging results of the revised Des Plaines program are shown below:

Year	Accidents	Contacts	Warnings	Tickets
1976	31			
1977	28	6,166	4739	734
1978	18	22,297	3783	270

Data Source: Des Moines and Niles Police Depts.

The cost of the program was the salary of the bicycle officer plus about $14,000 for summer wardens and their uniforms. Revenue-sharing funds were used to assist the program. (38)

The town of Havre-de-Grace in Maryland experienced similar accident reductions when a vigorous enforcement program was launched. During the first year the program was initiated, accidents dropped 75% from the 61 accidents occurring during the base year. A 15% reduction was experienced the next year, with only 3 accidents during 1978 needing hospital attention. The Lieutenant in charge of the program thinks enforcement is very important, adding "How many people would obey the 55 mph speed limit without enforcement?" (39)

Madison, Wisconsin provides an example of accident increases as citations decrease. As shown in Figure 2-6, citations have decreased since 1971, and accidents have steadily increased.

2.4 Encouragement

As Richard Knapp of the CALTRANS Bicycle program stated, "The single most important action that can lead to an effective bicycle program in any agency is the adoption of an advocacy role." Advocacy of employer programs and use of the media are two of many ways to increase public awareness of bicycle transportation as an alternative. Education programs are also a means of encouragement.

2.4.1 Employer Programs and Facilities

Encouraging employers to provide some basic bicycle facilities for their staff can be an effective but inexpensive part of bicycle strategy. Employers may be more interested in providing facilities or programs such as parking, bike/car pool information, bike trip reimbursement, flexi-time and staggered work hours, and showers, if examples of other companies providing such benefits are provided. In addition, potential financial advantages to the company should be made as explicit as possible.

The most important incentive most employers can provide is secure bicycle parking facilities. In many areas, bicycle racks are sufficient. For example, companies in the Dallas area installing racks as part of an employer incentive program include the National Bank of Commerce, Sunoco, and the Dallas Morning News[1].

In higher crime areas, a more secure facility may be necessary such as that provided by the Children's Hospital in downtown Boston. Initially, bicycle racks were provided, since Boston fire regulations prohibit bicycles inside hospital buildings. However, the theft rate was high. Therefore, several years ago the hospital began providing bicycle parking services in the hospital's conveniently located multi-story automobile parking garage. Although staff are charged for parking cars in the garage, the hospital permits employees to park their bikes free of charge in a special covered, fenced, and padlocked bicycle storage area within view of the garage attendent. A single

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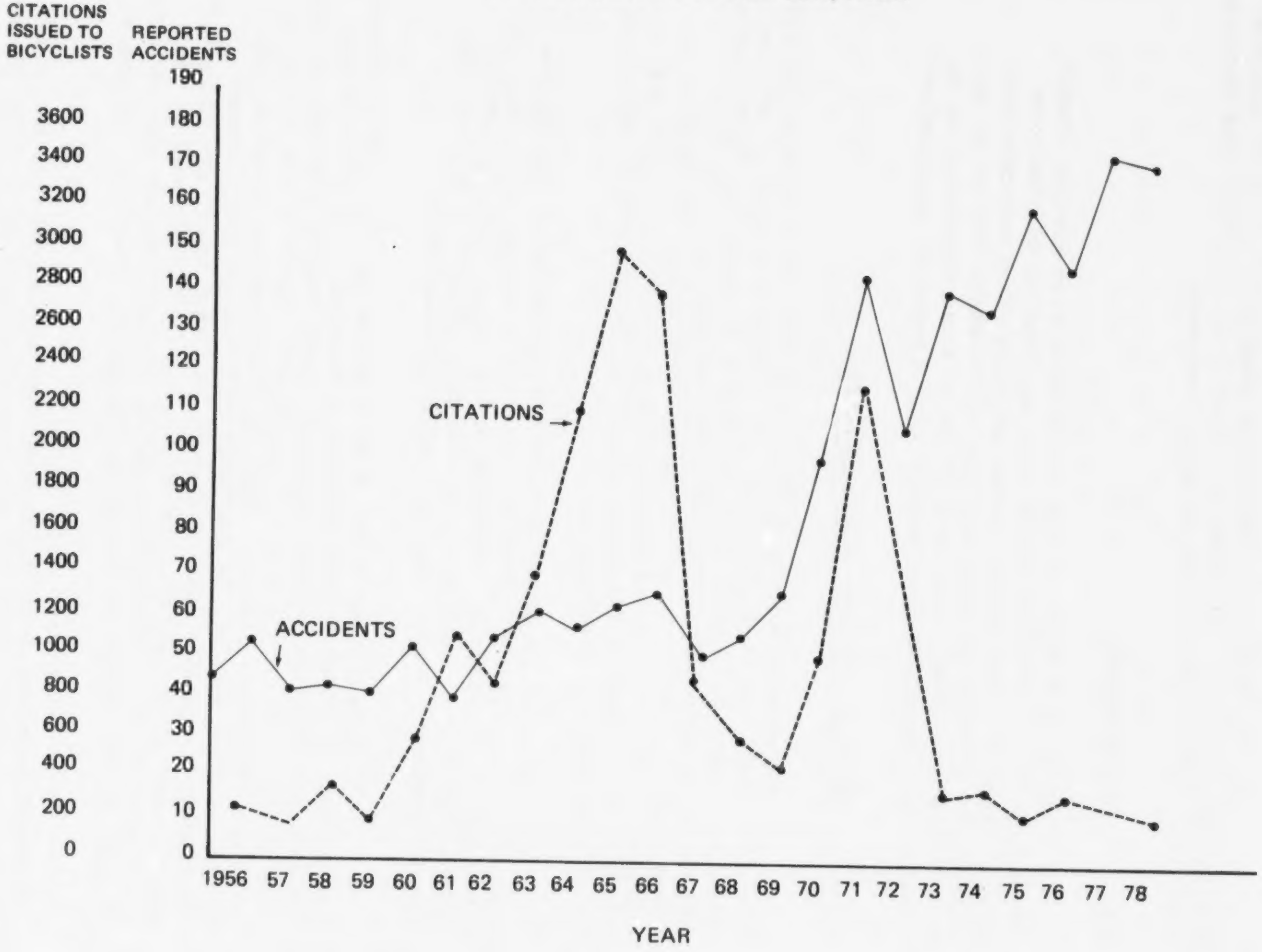
[1] Employer Incentive Regulations encourage installation of bicycle facilities. Such regulations are strongly encouraged by both EPA and DOT, and are one of the more popular transportation measures. Contact the bicycle coordinator at the regional EPA office (see Appendix B) for more information.

Figure 2-6
CITATIONS ISSUED TO BICYCLISTS AND BICYCLE ACCIDENTS REPORTED BY YEAR, CITY OF MADISON, WISC.



Source: "Bicycle Usage, Accident, Citation, Licensing, and Theft Trends for the City of Madison", Madison Department of Transportation, 1978.

padlock key is kept at the attendent's booth and employee identification is required before the key can be borrowed to unlock a bike. In addition, individual locks are required for each bike. As a result, thefts have been minimal. As an additional benefit, the hospital carries an insurance policy which covers all but a $10 deductible in case of theft.

About 250 employees a day use the bicycle parking facility, according to the parking attendant. The hospital official in charge of the program[1] has considered charging for bicycle parking but feels the financial benefits to the hospital outweigh the cost of providing the service (40). Automobile parking facilities are already overtaxed, and the cost of constructing and operating new parking facilities to accomodate bicyclists who would otherwise drive their cars would cost more than the foregone parking revenue and other costs of the bicycle parking program.

At the Federal level, a new General Services Administration (GSA) directive of June 1979 (41) states that "GSA will provide adequate bicycle parking facilities to encourage the use of bicycles for commuting purposes" and that the intention is to develop and implement an effective and safe bicycle parking program. A survey to determine need is recommended. Clothing lockers can also be provided, and existing shower facilities made available for use by cyclists where practical.

Shower facilities and a place to change clothing after bicycle commuting in hot and humid urban areas are almost a necessity. Some employers believe investment in such facilities as part of employee physical fitness programs and benefit packages is financially beneficial to the company. Benefits to the company may include lower absenteeism, higher productivity resulting from better health, and improved employee satisfaction with company benefit packages (42).

Examples of shower provision for private employees include construction by developers in the Stanford, California Industrial Park (43) and by Abt Associates Inc. in Cambridge in a new addition.

On the federal level, showers can be justified for bicycle commuters if bicycle commuting is a part of an approved physical fitness program, under December 1978 GSA guidelines (44). The Washington, D.C. headquarters of EPA is an example of a Federal agency installing showers (5 showers were installed in 1976).

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[1] Additional information is available from Mr. Robert Einsidler, Manager of Special Services, Children's Hospital, 300 Longwood Avenue, Boston, Mass. 02115.

In order to encourage greater use of the bicycle as a commuting alternative, other kinds of incentives can be developed by the employer. These incentives may include the following:

- Employee reimbursement for bicycle travel mileage when using a bicycle for business purposes
- Rebate of the monthly motor vehicle parking space rental cost (if a normally provided company benefit) to the bicycle commuter (former automobile driver) in cash.
- Purchase by the employer of a special bicycle lock for each employee who is a bicycle commuter.

An example of a special incentive offered to employees is provided by the Salz Leathers Tannery in Santa Cruz, California. A $10 subsidy is given for the purchase of a new 10-speed high performance bicycle. In addition, the bicycle is financed by a payroll deduction plan over a period of 90 days. About 50% of the 260 person staff has taken advantage of the plan, with about 20% of the staff riding their bikes fairly regularly (45).

Another example is the bicycle travel expense reimbursement policy of the Northeast Solar Energy Center in Cambridge, Mass. The policy was initiated when an employee, Steve Brown, applied for reimbursement for a 70 mile trip over a weekend to a business meeting in 1978. As a result, the company president approved a policy of 4¢/mile reimbursement for business (non-commuting) use of bicycles (car use reimbursement in 17¢/mile) (46)[1].

2.4.2 Public Awareness

Bicycle use may be increased by publicizing advantages through the media, obtaining endorsement by public officials, and distributing bicycle maps indicating safe or attractive bicycle routes.

Endorsement, encouragement, and support of bicycling by officials and employers can be important. An example of employer support is contained in Figure 2-7. In this memo, EPA Administrator Costle provides top-level policy support to provision of bicycle commuting facilities within his own organization. Each EPA Regional

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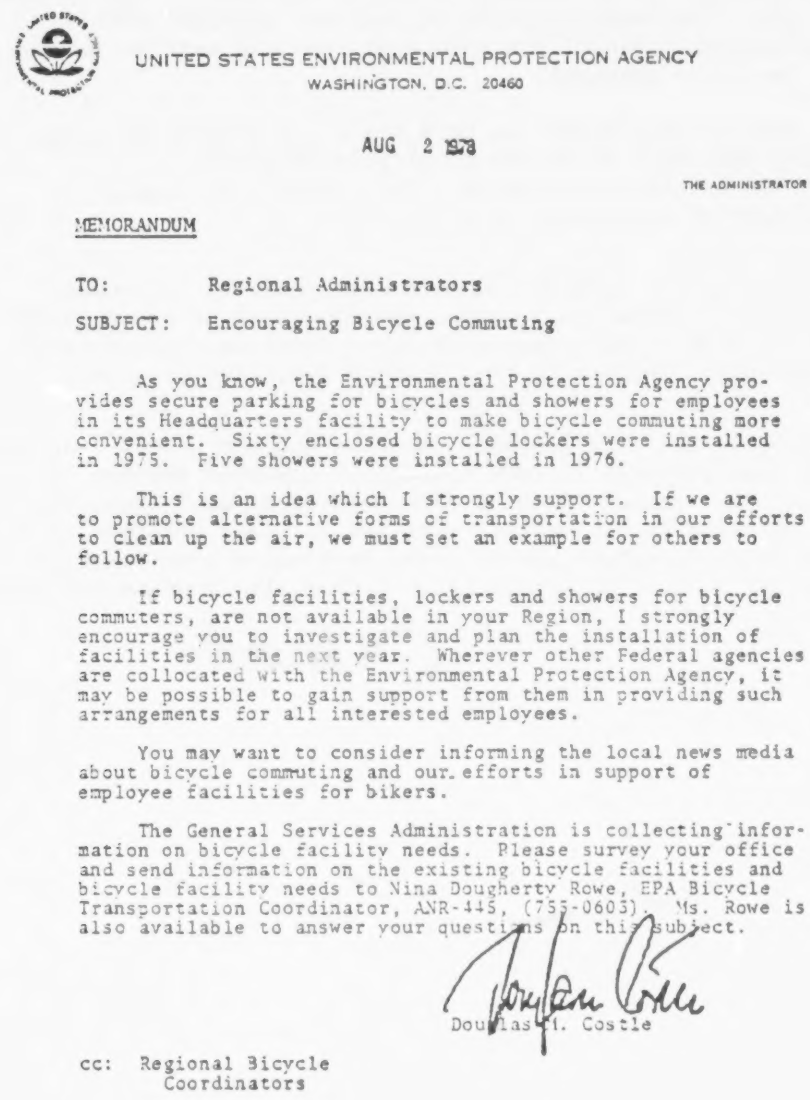
[1] For more information, contact Steve Brown or Bob Mitchell, Director of Communications, at (617) 661-3500.

Figure 2-7

BICYCLING SUPPORT BY AGENCY ADMINISTRATOR



UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

AUG 2 1978

THE ADMINISTRATOR

MEMORANDUM

TO: Regional Administrators

SUBJECT: Encouraging Bicycle Commuting

As you know, the Environmental Protection Agency provides secure parking for bicycles and showers for employees in its Headquarters facility to make bicycle commuting more convenient. Sixty enclosed bicycle lockers were installed in 1975. Five showers were installed in 1976.

This is an idea which I strongly support. If we are to promote alternative forms of transportation in our efforts to clean up the air, we must set an example for others to follow.

If bicycle facilities, lockers and showers for bicycle commuters, are not available in your Region, I strongly encourage you to investigate and plan the installation of facilities in the next year. Wherever other Federal agencies are collocated with the Environmental Protection Agency, it may be possible to gain support from them in providing such arrangements for all interested employees.

You may want to consider informing the local news media about bicycle commuting and our efforts in support of employee facilities for bikers.

The General Services Administration is collecting information on bicycle facility needs. Please survey your office and send information on the existing bicycle facilities and bicycle facility needs to Nina Dougherty Rowe, EPA Bicycle Transportation Coordinator, ANR-445, (755-0603). Ms. Rowe is also available to answer your questions on this subject.

Douglas M. Costle

cc: Regional Bicycle
Coordinators

Office has responded. One office, for instance, is providing theft-resistant bicycle locks for use by commuters in the office.

Local transportation agencies sometimes take their lead from state transportation agencies, particularly in activities which the state helps to fund. State officials may be assisted in their local bicycle-related information efforts if they are provided with a list of knowledgeable bicyclists upon whom they can call for advice on bicycle issues or problems.

Formal resolutions can be written and adopted by local city councils that draw attention to bicycle commuting, and encourage local citizens to bicycle. The Denver City Council passed this type of resolution in 1971.

Similarly, a governor or mayor can publicly recognize bicycling as an environmentally safe, energy-efficient and enjoyable transportation mode. The governor of North Carolina, for instance, has given strong public support to that state's bicycling program.

Bicycle Hot Line programs can also enhance public awareness. Examples of such programs include a "Bicycle Commuter Service" in Portland, Oregon. Funded by the Oregon Department of Energy, the service is operated in conjunction with the Portland Wheelmen, and uses a "233-BIKE" telephone number. The Washington Area Bicyclist Association and Seattle's Cascade Bicycle Club also operate hot lines.

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SECTION 3: EVALUATING BICYCLE STRATEGY IMPACT

3.0 Introduction

State and local officials, planners, or other individuals considering the use of bicycle measures discussed in Section 2 need to evaluate the likely effects of alternative programs in their own area. Careful evaluation of the potential impacts and costs of alternative measures will help in the selection of the most effective programs, given the funds available.

In addition to the information on existing levels of bicycle use and other local factors likely to affect the impact of bicycle programs (see Figure 1-8, Section 1 for a summary of factors), information on the effectiveness of different types of bicycle programs is needed. With reliable data on actual program impacts (e.g. modal shift from car to bicycle trips), estimates can be made of air quality impacts, health effects, gasoline savings, economic impacts, and program costs.

This section provides a summary of literature on bicycle program impacts using seven measures of effectiveness. The section continues with a discussion of other impacts which should be considered during the analysis of alternative bicycle measures. A concluding section indicates how bicycle measures can compliment other transportation measures.

3.1 Summary of Quantitative Data on Bicycle Program Effectiveness

A literature search was undertaken to provide localities, considering implementation of a bicycle strategy,with reliable data on the types and extent of impacts of alternative bicycle measures. The results of the search are presented in this section, and are summarized in Figure 3-1.

One primary and six secondary measures of effectiveness were utilized in the analysis framework for each type of bicycle program (e.g. barrier removal). The effectiveness measures included changes in:

Primary measure

- modal shift from auto trips to bicycle trips

Secondary measures

- travel time
- bicycle accidents
- knowledge retention
- behavioral change
- bicycle theft
- bicycle returns

For air quality planning purposes, the primary measure of effectiveness is modal shift associated with bicycle program options. More specifically, modal shift from motor vehicle trips to bicycle

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trips is needed to calculate actual and potential emission reduction effects of bicycle programs.[1] This modal shift data also permits calculation of energy savings associated with bicycle programs.

Secondary measures were also examined, on the assumption that program effectiveness in these areas may contribute to some modal choice decisions. Some recent studies have indicated that convenience (e.g., time savings) is a greater determinant than comfort in modal choice decisions. Therefore, travel time change was included as a measure of effectiveness.

Fear of accidents, particularly motor vehicle accidents, is a major deterrent to bicycle riding (see Figure 1-10). To the extent that potential bicycle riders are deterred by actual-- rather than imagined--risks, provision (and knowledge) of a safer riding environment should contribute to increased bicycle trips.

A variety of bicycle education programs have been initiated. It is obvious that safety information should be made available to current and potential bicycle users. To ascertain which education programs are most promising, "knowledge retention" and "behavioral change" are included as measures of effectiveness. Programs to encourage increased bicycle use can also be evaluated using these two measures.

Bicycle theft is a deterrent to increased bicycle use. Bicycle parking facilities, police department enforcement, and bicycle registration may all reduce bicycle theft. In addition, registration should also facilitate returns of stolen registered bikes. Therefore, "bicycle theft" and "bicycle returns" were included as measures of effectiveness on the hypothesis that theft reduction may encourage additional bicycle trip-making.

Since little cost data is available, an estimate of whether the program cost is "low", "medium", or "high", relative to costs of other program options is used. For example, under the "bikeway" category, use of sidewalks ("low") is a lower cost option than installation of signs ("medium"), which in turn is lower cost than construction of separated bikepaths ("high").

Figure 3-1 presents the alternative program options and summarizes the results of the literature search for quantitative data on program effectiveness (e.g. modal shift, changes in travel time, accidents, learning, bike theft and return). Unfortunately, little quantiative documentation of program effectiveness could be located. Further, some of the literature containing quantative data raised methodological questions. For example, control groups and multivariate analysis were not generally employed to permit analysis of the extent to which factors other than the bicycle programs may have affected outcomes.

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[1] Modal shift data should include number of trips, trip length, auto travel speeds, location, and time of day for refined air quality and energy-saving calculations.

Figure 3-1:
Summary of Bicycle Options by Measures of Effectiveness and Estimated Costs

Bicycle Program Option	Measures of Effectiveness								Estimated Relative Cost
				Learning					
I. Facility Engineering	Modal Shift (To Bicycle Trips)	Travel Time Changes	Bicycle Accidents	Knowledge Retention	Behavioral Change	Bicycle Theft	Bicycle Returns	Data Source and Program Location[1]	
Bikeways									
Shoulder Upgrading (routine)									L
Use of Free Shoulder									L
Wide Curb Lanes									L
Use of Sidewalks			+ 54% car/bike					(A) Palo Alto, CA	L
Bikeway Signs			+ 24% city-wide					(B) Palo Alto, CA	M
Special Use Signs									M
Bikelanes			−18% car/bike					(A) Palo Alto, CA	M
Shared Lanes			+ (car door accidents)						
Exclusive Lanes	(+ 10% new riders)							(C) Washington, D.C.	
Mixed			(— total and serious)					(D) U.S. LAW Survey	
			−37% car/bike (−33% improper cyclist left turn) (−87% mid-block intersection cyclist (−72% wrongway					(E) Davis, CA	
Bikepaths			−non-intersection					(F) Netherlands	H
			—					(G) Netherlands	
			−60% (with curb separation) (+ motorist right turn at intersection)					(H) Denmark	
			−45% car/bike, moped −20%-40% bike/moped (+ motorist right turn at intersection (−bicyclist left turn at intersection) (−fatalities outside intersection) (+ non-fatalities outside intersection)					(I) France	
			(+ rate for total and serious)					(D) U.S. LAW Survey	

[1] References are given at the end of Figure 1.

Figure 3-1:
Summary of Bicycle Options by Measures of Effectiveness and Estimated Costs, continued.

Bicycle Program Option	Measures of Effectiveness								Estimated Relative Cost
				Learning					
	Modal Shift (To Bicycle Trips)	Travel Time Changes	Bicycle Accidents	Knowledge Retention	Behavioral Change	Bicycle Theft	Bicycle Returns	Data Source and Program Location[1]	
I. Facility Engineering (continued)									
Maintenance									L-H
Supporting Facilities									
Parallel Grate Replacement									M
Traffic Signals									H
Lighting									H
Barrier Removal Bridge	(+ 50% new riders) + 29% car to bike	+ 62%						(J) Eugene, OR	H

[1] References are given at the end of Figure 1.

Figure 3-1:
Summary of Bicycle Options by Measures of Effectiveness and Estimated Costs, continued.

Bicycle Program Option	Measures of Effectiveness								Estimated Relative Cost
	Modal Shift (To Bicycle Trips)	Travel Time Changes	Bicycle Accidents	Learning: Knowledge Retention	Learning: Behavioral Change	Bicycle Theft	Bicycle Returns	Data Source and Program Location[1]	
I. Facility Engineering (continued)									
Intermodal Links									
Use of Existing Space on Ferries, Trains									L
Van Racks									L
Racks at Stations									M
Lockers at Stations									H
Special Bus Racks		(Removed travel Barrier)						(K) San Diego, CA	M
Parking Facilities									
Racks									M
Lockers									H
II. Safety Education									
Adult Education									
Effective Cycling Training									M
Driver Education									L
Teacher Training									M
Police Training									M
Juvenile Education									
Safety Towns			+ (toy town)					(L) Sweden	H
Education by School Teachers			—	80%/6 mo.				(L) Sterling, Ill.	L - M
Education by Police School Education, Non-aggressive Safety Enforcement			+ 35% ('72 – '75)					(M) Des Plaines, Ill.	L - M

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[1] References are given at the end of Figure 1.

Figure 3-1:
Summary of Bicycle Options by Measures of Effectiveness and Estimated Costs, continued.

Bicycle Program Option	Measures of Effectiveness								Estimated Relative Cost
				Learning					
	Modal Shift (To Bicycle Trips)	Travel Time Changes	Bicycle Accidents	Knowledge Retention	Behavioral Change	Bicycle Theft	Bicycle Returns	Data Source and Program Location[1]	
III. Safety Enforcement									
Aggressive Enforcement and Education by Police			–82% ('74 – '75)					(M) Niles, Ill.	M
Bicycle Court			–75% ('74 – '75)					(N) Harve de Grace, Md.	L
Bicycle Registration							+ (64% return)	(O) State of Minnesota	L (after start-up)
IV. Encouragement									
Employer Programs									
Recognition									L
Flexi-time									L
Bike Trip Reimbursement									L
Use of Indoor Space for parking									L-H
Bike Racks									M
Bike Lockers									H
Showers									H
Public Awareness									
Use of Free Media Services									L
Use of Purchased Media Services									H
Production and Distribution of Bicycle Route Maps									M

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[1] References are given at the end of Figure 1.

REFERENCES, FIGURE 3-1

(A) T.T. Noguchi, C.E. Walker, "Bicycle Route System--Evaluation and Status Report" (City of Palo Alto: California), January 17, 1974.

(B) "The Urban Bicycle Route System for the City of Palo Alto", (City of Palo Alto: California), mimeograph, 1973.

(C) DeLeuw Cather and SpokesWomen, Bikeway Design Evaluation (for the D.C. DOT: Washington, D.C.), December 1978.

(D) J.A. Kaplan, *Characteristics of the Regular Adult Bicycle User*, (Federal Highway Administration, San Francisco, California), July 1975.

(E) D.T. Smith, Jr., Safety and Locational Criteria for Bicycle Facilities, Final Report (DeLeuw Cather for SHWA, U.S. Department of Transportation: Washington, D.C.), October 1975.

(F) Koninklijke Nederlandsche Toeristenbond, Fietspaden enoversteek-plaatsen (Bicycle Paths and Cycle-Crossings), Verkeersonemorandum No. 4, van de Verkeersafdeling van de ANWB (Traffic Division of the Algemene Nederlandse Wiedri ders Bond), 2nd Revised Edition, Amsterdam, Holland, December 1978.

(G) I.M. Aarondse, Article in Verkeerstechniek #5, 1964.

(H) Radet for Trafik sikkerhedsforskning, Cykelstiers Betydning for Faerdseessikkerheden, Rapport 1 (Statens Trykningskontor: Copenhagen, Denmark), 1969.

(I) S. Goldberg and J. C. Gazeres, "Les Accidents sur Pistes Cyclables" (Organisme National de Securite Fontiere, Bulletin No. 1), September 1962.

(J) *Greenway Bike Bridge, Evaluation Report--Phase I* (City of Eugene Public Works: Eugene, Oregon), November 1978.

(K) C. Horne and V. Hurst, *Transit Bus-Bicycle Rack Demonstration Project* (San Diego, California: CALTRANS District 11, State of California), May 1977.

(L) Conversation with Donald LaFond, State of Maryland, April 22, 1979.

(M) Department of Police, mimeographed paper (City of Des Plaines, Illinois), no date.

(N) Conversation with Lt. Wm. Kristie, Safety Officer, Police Department, Harve-de-Grace, Maryland, April 22, 1979.

(O) M.D. Connelly and E.R. Lofton, North Carolina Bicycle Registration Study (Research Triangle Institute, for the North Carolina Bicycle Program, DOT, Raleigh, N.C.), November 15, 1978.

More specifically, only one study contained quantative data on the modal shift associated with a bicycle measure from car to bicycle trips. This study examined the Oregon bicycle bridge. Approximately 30% of the trips involved use of bicycles rather than cars. This same evaluation indicated a substantial time savings resulting from the bridge construction.

Most of the quantitative impact data located was for changes in bicycle accidents. Data from Palo Alto indicates that bicycle accidents increased when sidewalk riding was permitted, and when the first generation of bike signs were installed. Car/bike accidents decreased with the use of shared bikelanes, although bicycle/car door accidents increased. Both total and serious accidents were relatively less common for riders using bikelanes and surveyed in the Kaplan (LAW) survey. The Davis, California bikelane experience was similar.

European data indicates that bicycle/car accidents were less common or decreased when bikepaths were used, although accidents associated with motorist right turns at intersections increased. Kaplan's study, however, indicated higher rates of total and serious accidents for those surveyed when using bikepaths. Kaplan hypothesized that cyclists may use less caution on this type of facility, since they are separated from motor vehicles except at intersections, and may therefore be more subject to other causes of accidents such as falls on slippery gravel, or collisions with fixed objects.

The limited data on impacts of juvenile education is contradictory. However, the safety town experiments in Sweden imply that care should be exercised in using "toy" traffic situations lest children assume that actual use of roads is equally safe. Retention tests in Maryland indicate that much of the information shown in the film strips developed by the state was remembered.

Agressive safety enforcement is associated with accident reductions in three programs - police department programs in Des Plaines and Niles, Illinois, and in Harve de Grace, Maryland. Finally, the bicycle registration program in Minnesota was quite successful during its first year of operation in returning stolen bicycles to their owners.

In addition to the problems of little quantitative data being available, some of these programs were implemented without the support of a comprehensive approach. Therefore, observed impacts are likely to be smaller than would be expected in broader programs composed of mutually reinforcing components.

3.2 Need for Comprehensive Bicycle Program Implementation with Evaluation

The data limitations on bicycle program costs and outcomes were indicated in the previous section. Such data limitations obviously restrict the ability of metropolitan planning agencies, states, and localities to predict potential outcomes of bicycle strategy implementation to reduce air pollution. In view of the relatively high levels of bicycle use in the few urban areas which have implemented comprehensive[1] bicycle programs (e.g. Davis, California and Madison, Wisconsin), and potential latent demand implied by the widespread purchase and ownership of bicycles in the U.S.[2], common sense indicates that the effects are likely to be positive. Furthermore, MPOs, states, and localities implementing comprehensive bicycle strategies, carefully documenting costs and outcomes, and publicizing the results, will be making a substantial contribution to our level of knowledge about bicycle program effects. In fact, a strong argument can be made for federal funding assistance for such programs, since the benefits from carefully evaluated comprehensive bicycle programs will be national.

The greatest modal shift and air quality impact effects would be expected in areas with larger numbers of positive factors influencing bicycling (see Figure 1-8), and where higher levels of institutional, political, and public support for bicycling exist, or can be generated. However, since so little quantitative data on bicycle program effects is available, careful analysis of comprehensive bicycle program implementation in areas which appear less promising will also make a major contribution to our level of knowledge. Bicycle measures should be viewed as demonstration measures, whose effects are expected to be generally positive, but whose magnitude of impact is still unknown. It is important to emphasize that comprehensive bicycle programs are being discussed. Such programs include a range of mutually reinforcing activities such as bicycle facility construction, safety education and enforcement activities, employer programs, and publicity about the enjoyable aspects of bicycling (see Figure 3-10 for illustrations). Isolated improvements, such as bicycle path construction without provision for secure parking, without careful attention to intersections, and without publicity, are unlikely to have an appreciable impact on modal shift except in unusual situations.

Areas undertaking implementation and evaluation of a comprehensive bicycle program should take advantage of national funding sources, whenever possible, since reliable data on the cost-effectiveness of such programs will be of national value. The Environmental

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[1] A comprehensive program is one with a range of mutually reinforcing activities.

[2] As noted in "How to Calculate Emission Benefits of Each Control Measure: Bicycle Lanes and Storage Facilities", How to Prepare The Transportation Portion of your State Air Quality Implementation Plan, (Wash., D.C.: U.S. Dept. of Transportation, Federal Highway Administration and U.S. Environmental Protection Agency), Nov. 1978.

Protection Agency's section 175 program can provide planning assistance. This and other potential sources of financial assistance are discussed in Section 4, and summarized in Appendix E.

Evaluation and reporting plans should be developed as an integral part of bicycle strategy development. The first step in evaluating a program is to obtain good baseline data on bicycle use, attitudes, and related items such as bicycle accidents before program implementation. Survey data is particularly useful, although existing agencies may provide additional data (e.g. police department records on bicycle accidents and thefts). Obviously, the questions to be asked will vary depending on the type of bicycle program to be implemented. An example of a baseline survey is the 1974 study of bicycle use sponsored by the Pennsylvania Dept. of Transportation.[1]

Reliable data can be obtained in most cases through use of a sample, rather than a survey of the entire population. When designing the sampling strategy, program staff should consult one or more of the many excellent books on survey design[2], consult with available experts in local, metropolitan, or state government, and/or obtain help from outside experts.

A plan is also needed for evaluating the bicycle program once implementation has started. This plan should be developed before the bicycle program is initiated, and the plan should include what data is to be obtained, how the data will be gotten, and who is responsible for getting and analyzing the data. A follow-up survey, or surveys, will provide particularly useful information on items such as modal shift from car to bicycle trips, or the extent to which new bicyclists feel the programs encouraged modal shift. In determining modal shift, local, state, and/or federal level transportation staff assistance, or outside expert advice should be obtained by bicycle program staff needing technical assistance.

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[1] A.C. Nielsen Company and Barton-Aschman Associates, Inc., Survey on Bicycling Activity in the Commonwealth of Pennsylvania (for the Pennsylvania Dept. of Transportation, Harrisburg, Pa.), November 1974.

[2] For example, Survey Research Methods, E.R. Babbie, (Wadsworth Press), 1972; Survey & Opinion Research: Procedures for Processing & Analysis, J.A. Sonquist and W.C. Dunkelburg, (Prentice-Hall), 1977; Social Statistics, H.M. Blalock, Jr.,(McGraw-Hill), 1972; Data Analysis and Regression, F. Mosteller & J.W. Tukey, (Addison-Wesley), 1977; Foundations of Behavioral Research, F.N. Kerlinger, (Holt, Rinehart and Winston, Inc.), 1973.

Other sources of data may also be useful in evaluating program effects. Such sources might include police department records on accident reductions, reported bicycle thefts, and stolen bicycles returned to their owners through a registration system. The school system may provide data on retention of safety education programs, based on test results. Early consultation with providers of such information will help insure that the data desired is actually collected and made available.

States and local governments will be responsible for most of the program implementation. However, metropolitan planning agencies may be able to provide useful assistance during the planning and evaluation phases. These phases require some technical skills which may not be readily accessible to local governments. In addition to skills, metropolitan planning agencies have access to some special funding programs, such as EPA's section 175 urban air quality planning grants.

The final stage, writing up and dissemination of the bicycle program results, can be handled by any or all levels of government or by private individuals. This stage is in some ways the most important part of the process, since others outside the program area can benefit only if they know about the results. A variety of dissemination methods should be used if possible, including publication (e.g. in The Bicycle Forum, transportation journals, or planning publications), use of the media (e.g. TV, radio, regional or national newspapers), informing federal-level bicycle coordinators (e.g. the EPA and DOT bicycle coordinators) of program results, and presentation of program results at conferences and conventions. Publicizing program experiences, costs, and impacts will not only benefit other areas considering implementation of bicycle programs, but will provide national recognition to the program designers, implementers, evaluators, and particularly to the individual(s) disseminating the results.

Specific program impacts in the areas of air quality, health, gasoline savings, and economic effects which should be considered during the evaluation phase are discussed in the following sections.

3.3 Estimating Air Quality Impacts

The calculation of the air quality impacts associated with bicycle transportation strategies depends on three major factors:

- the percentage and location of vehicular trips and VMT which can feasibly be shifted to bicycle use (modal shift potential);
- the significance and magnitude of the related vehicular pollutants;
- the net effect this shift would have on vehicular pollutant levels.

Modal shift to bicycles will be a function of the over twenty local factors identified in Figure 1-8 and discussed in Section 1.2, bicycle programs available for implementation (see Section 2), and their effectiveness (Section 3.1). As noted earlier, local factors are highly variable, and additional comprehensive bicycle program implementation and evaluation is needed before the magnitude of program impacts and air quality improvements can be reliably estimated on an aggregate level. Local areas with survey data on bicycle use already available should utilize such data for air quality estimates. Otherwise, plans should be developed to obtain the necessary data.

Ideally, survey data would be obtained on the number and percentage of auto drivers (or children being driven) who would substitute bicycle travel if a comprehensive bicycle program was implemented. The limited data on modes of travel for which bicycle travel substituted indicates that a substantial percentage of bicycle riders would other have driven a car, or been a passenger. For example, the bicycle bridge constructed in Eugene, Oregon generated many new trips which would otherwise have been taken by car (see Figure 3-1). A statewide survey in Pennsylvania indicated that on average, 58% of those riding bicycles would otherwise have either driven or ridden in a car. Only 2% would have taken a bus (see Figure 3-2), so transit diversion is not a major concern. When alternative modes were examined for bicyclists in central cities over 500,000 population, where good bus service is most likely, only 4% of the bicyclists would have used a bus. Even bicycling by children and teenagers under 15 years old substitutes heavily for car travel (as a passenger), with 36% of those under 6, 38% of those 6-11, and 43% of those 12-15 using a bicycle rather than being driven to their destinations.

Figure 3-2

PRIMARY MODES OF TRAVEL FOR WHICH THE BICYCLE SUBSTITUTED, BY AGE OF BICYCLISTS

Age	Walking	Driving Car	Passenger in Car	Bus	Other[1]
Under 6	60%	-	36%	1%	3%
6-11	58%	-	38%	2%	2%
12-15	50%	1%	43%	2%	4%
16-19	28%	42%	22%	3%	5%
20-23	17%	69%	7%	1%	6%
24-29	20%	71%	7%	2%	-
30-44	20%	66%	9%	1%	4%
45-59	15%	73%	8%	3%	1%
60+	27%	59%	-	11%	3%
Total	37%	33%	25%	2%	3%

[1] Other includes motorcycle and wouldn't have gone categories.

Source: A.D. Nielsen Company and Barton-Aschman Associates, Inc., Survey on Bicycling Activity in the Commonwealth of Pennsylvania (for the Pennsylvania Department of Transportation, Harrisburg, Pa.), November 1974.

The statistics in Figure 3-2 on adult bicycle riders indicate even heavier automobile substitution. For those from 20-59 years of age, three quarters or more of each age category would either have driven a car or been a passenger in a car. Even for those 60 and over, 59% would otherwise have driven a car. If mode substitution patterns are similar for new bicycle trips made by existing riders, and/or for new bicycle riders, over half of all bicycle trips will result in a direct reduction of VMT and associated emissions.[1]

Modal shift to bicycles will be a function of the over twenty local factors identified in Figure 1-8 and discussed in Section 1.2, bicycle programs available for implementation (see Section 2), and their effectiveness (Section 3.1).

The significance and magnitude of related vehicular pollutants should also determine which bicycle programs are implemented. This discussion focuses on automobile use as the primary source of vehicular pollutants which would be most significantly affected by a shift to bicycle transportation. Auto pollutants include carbon monoxide (CO), hydrocarbons (HC), oxides of nitrogen (NO_x), particulates, lead, sulfates and asbestos.

The most significant of the auto pollutants in terms of total emissions is carbon monoxide (CO). In many urban areas, over 90% of CO emissions from all sources are produced by the automobile (1). Therefore, a major benefit to air quality resulting from a shift to bicycle transportation would be a reduction in ambient levels of CO.

In order to illustrate potential net reduction in urban CO, a hypothetical case study of a few major parameters and their interrelationships is used in this section. Many automobile trips in urban areas are short, low-speed trips. This phenomenon is illustrated in Figure 3-3, which lists average automobile miles traveled projected for the year 1980 for an urban regional planning district (2). Travel is separated into six speed categories.[2]

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[1] Assuming both trips made driving a car and as a passenger in a car (e.g. a child being driven to a destination) are replaced by bicycle trips.

[2] Speed categories are used in the example as illustrative proxies for the more complex set of factors (e.g. speed, trip length, location, vehicle mix, temperature, etc.) which should ideally be considered for any particular locality.

Figure 3-3

AVERAGE AUTOMOBILE MILES TRAVELED IN AN URBAN AREA PROJECTED TO 1980

Average Speed Category	Annual Miles Traveled
5 m.p.h.	26,000
10 m.p.h.	65,000
15 m.p.h.	320,000
20 m.p.h.	300,000
25 m.p.h.	200,000
50 m.p.h.	310,000

Figure 3-4 shows the average emissions of CO in terms of grams per mile associated with each speed category. These emissions were calculated from the emission factors contained in EPA's Mobile Source Emission Factors (3). They represent a typical age and annual travel distribution of light duty passenger vehicles under average urban travel conditions.

Figure 3-4

AVERAGE CO EMISSIONS FOR LIGHT DUTY PASSENGER VEHICLES IN AN URBAN AREA PROJECTED TO 1980

Average Speed Category	CO Emissions (grams/mile)
5 m.p.h.	140
10 m.p.h.	100
15 m.p.h.	70
20 m.p.h.	55
25 m.p.h.	45
50 m.p.h.	25

It is important to recognize that CO emissions are significantly higher at lower speeds. For this reason, it could be possible to achieve significant reductions in emissions by shifting low speed automobile travel to bicycles. Let us assume that a total of 2.4%[1] of the annual travel shown in Figure 3-3 could be shifted to bicycle use. Let us further assume that this shift would be biased towards the lowest speed categories.

We then calculate the total emissions produced before and after the shift. Table 3-5 demonstrates this analysis. We see that a modal shift to bicycle use of 2.4% could theoretically result in a 5% reduction in total CO emissions. Since ambient concentrations of CO are directly proportional to emissions, the same reduction of 5% could be achieved in ambient CO concentrations.

This CO reduction would be manifested in "hot spot" areas of high CO levels associated with urban traffic congestion. Theoretically, this could result in an achievement of CO standards for those areas where the standards are marginally exceeded, especially if the average modal shifts displayed in Table 3-5 are contained in the peak rush hour traffic periods and in areas of particularly heavy traffic.

Several techniques for estimating bicycle demand by trip type and geographic area have been advanced (7-9). Targeting of bicycle programs to areas of heaviest travel (e.g. the CBD) and peak travel times (e.g. rush hour commuting) should result in greater reductions for those critical short term periods of severe CO standard violation.

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[1] As indicated in Figure 3-1, actual modal shift data is virtually non-existent. A modal shift of about 10% in Davis, California has, however, been attributed in part, at least, to provision of better bicycle facilities.

Survey data indicates a willingness to shift. For example, a survey of non-bikers in Madison, Wisconsin (4) indicated that 21% would ride a bicycle to work, 14% to school, 18% for shopping and 49% for recreation if better facilities were provided. A 1973 survey of commuter bicycling in Philadelphia indicated that with modest provisions of bicycle lanes and parking, 5% to 10% of all current commuters to the CBD would shift to bicycle use (5).

Figure 3-5

HYPOTHETICAL CASE STUDY OF NET REDUCTION IN CO EMISSIONS
DUE TO A SHIFT TO BICYCLE USE

	Average Speed Category	CO g/VMT*	Annual VMT	CO Metric Ton/Yr.	% Modal Shift	Reduction CO Metric Ton/Yr.	% Reduction CO
	5	140	25,000	3.64	15%	.55	15%
	10	100	65,000	6.50	10%	.65	10%
	15	70	320,000	22.40	5%	1.12	5%
	20	55	300,000	16.50	0.5%	.08	0.5%
	25	45	200,000	9.00	0.5%	.05	0.5%
	55	25	310,000	7.75	0%	.00	0.0%
Total			1,221,000	56.80	2.4%	2.91	5.1%

Hydrocarbon levels are also higher at lower speeds, and increase at levels similar to those of CO. In addition, CO levels provide rough indication of the direction of variation in other emission-related pollutants such as lead and asbestos (10-12). Oxides of nitrogen, however, are not produced at significantly higher rates at low speeds.

Other factors besides speed will affect emission production, including the number of cold starts (a trip made after a long engine-off period) and ambient temperature. Figure 3-6 illustrates the increase of CO and HC emissions as temperatures decrease and as cold starts increase.

Because of the large number of factors which affect bicycle use, and which vary widely across the U.S., integration of bicycle transportation evaluation with the local and regional transportation planning process is important. Such integrated planning will increase the likelihood of access to major local data sources, and professional expertise in specialized areas such as modeling and forecasting. Furthermore, modeling efforts which integrate enough factors to produce a reliable prediction of future bicycle use, given other proposed changes in the local transportation system, are likely to be beyond the budget of a bicycle program. Such efforts may, however, be feasible as part of a larger transportation planning process.

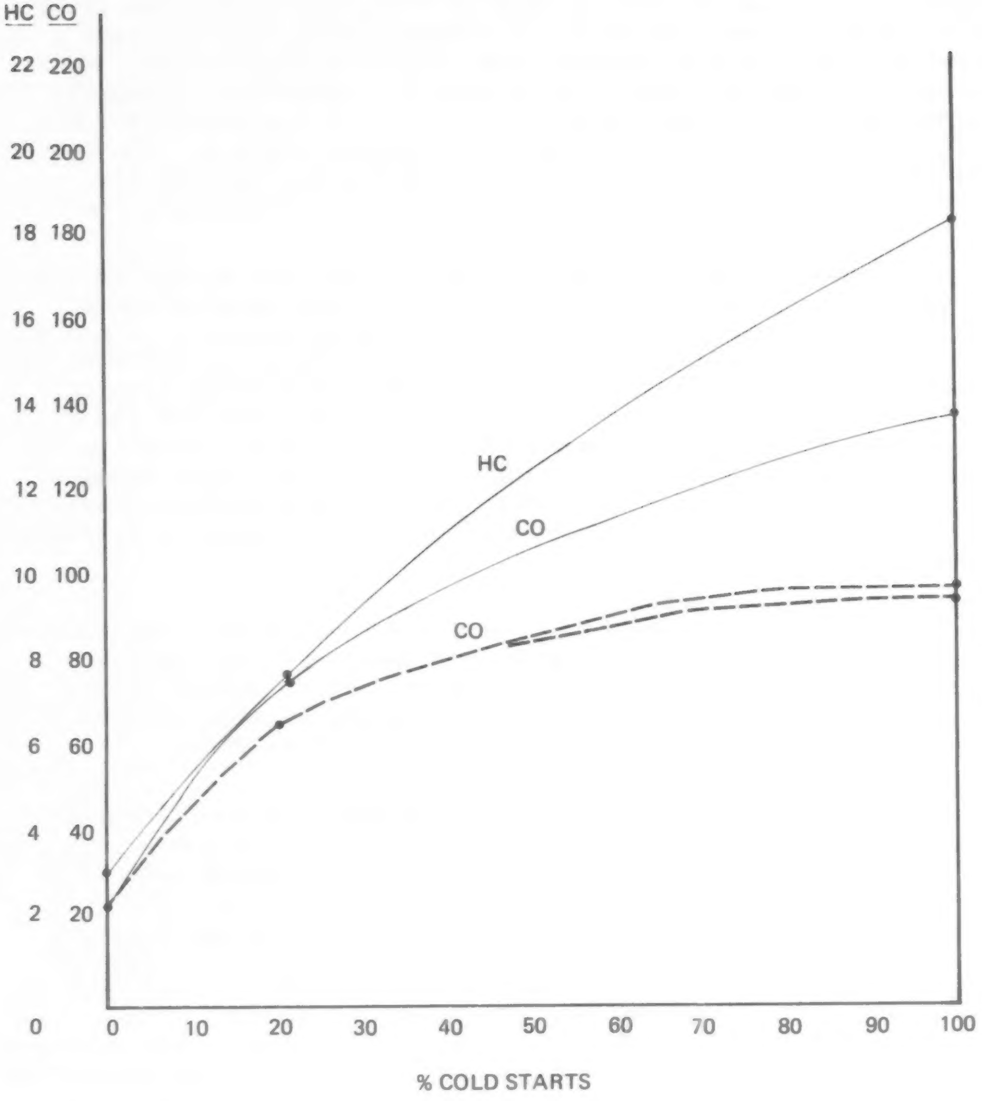
3.4 Effects of Emissions on Bicyclists

An analysis of air quality impacts of bicycle strategies would be incomplete without consideration of possible effects on bicyclists of riding in polluted environments. Unfortunately, empirical research in this area is limited. Certainly, exposure to pollutants is generally greater in traffic than in many other situations. For example, analysis of lead exposure inside buildings compared with exposure during driving indicates substantially increased levels of lead exposure in traffic (13).

A bicyclist breathes polluted air directly, whereas an automobile driver may be protected to some degree by the car. However, research by Spengler and others (14) on carbon monoxide exposure indicates that motorists and bicyclists experience about the same levels in Boston. Several possible reasons have been advanced for this finding.

Figure 3-6

RELATIONSHIP OF CO AND HC EMISSIONS TO TEMPERATURE AND COLD STARTS



Source of Data: **Mobile Source Emission Factors** (Washington, D.C., U.S. Environmental Protection Agency, EPA-400/9-78-005), March 1978. Tables F-1, F-3, F-4, F-6, F-19, F-21.

Legend: —— = Average ambient temperature of 25 °F
— — = Average ambient temperature of 75 °F

Note: Vehicle mix assumes 80.3% autos, 5.8% for each of the two light truck classes 4.5% heavy gas trucks, 3.5% heavy duty diesels, and 0.50 motorcycle VMT.

100% and 20.6% cold starts assume an average vehicle speed of 19.6 mi/hr., 0% cold starts assumes an average vehicle speed of 45 mi/hr.

Average emission factors are for 1980.

A cold start is representative of vehicle start-up after a long engine-off period.

Automobile air intakes are located in the lower front area of cars, near the exhaust emissions of the preceding car. Therefore, emissions such as carbon monoxide are taken in, particularly in heavy traffic, and circulated inside the car where they are inhaled by the driver. Bicycle riders, however, are normally located over to one side of the roadway rather than directly in back of cars. Bicyclists also breathe in air at least four feet above the roadway surface, and can move ahead of slow or stopped traffic (e.g. at lights or in traffic jams). However, respiration rates of bicyclists are higher than automobile drivers and the increased "dose" of polluted air received by the bicyclists has not yet been factored into exposure analyses. Furthermore, bicyclists breathing through their mouths may increase the penetration of particles into the upper and lower respiratory tract.

Research on CO exposures of bicyclists (10) by Kleiner and Spengler using portable CO monitors indicated that exposure was a function of traffic volume, street configuration, proximity of monitor to traffic and ventilation (air circulation). The study indicates no advantage to routing bicycles away from wide main thoroughfares to reduce CO exposures. In fact, CO exposures to cyclists were higher on narrow busy streets, independent of time of day. Wider streets may offer both greater separation of the bicyclist from traffic and more ventilation. Use of a portable CO monitor proved feasible, so localities could use this technique to determine precise CO exposure on different streets.

A recent U.S. Department of Transportation study on short-term health effects of bicycling in urban areas (15) did not find serious short-term health effects. However, the volunteers tested were all healthy young adult males. The results might be different if other demographic groups, such as children, were tested.

The toxic effects of smog have prompted several researchers to question the advisability of locating bicycle routes close to heavily traveled transportation routes (16,17). Research conducted on the effects of photochemical oxidants (ozone) on bicyclists concluded "a single one-hour exposure to levels of O_3 approximating current smog alert levels for oxidant can produce rather distinctive changes in lung function in the face of fairly severe aerobic work loads" (18). The researcher further stated that specific bikeway location is insensitive to oxidant levels since O_3 is formed from other pollutants and is dispersed over wide areas. However, the researcher suggested consideration of ambient levels of smog when evaluating the desirability of a bicycle strategy.

Considering fleet changes in the years to come, (e.g. more diesel engines), a special effort should be made to anticipate changes is exposures and potential health effects, such as sulfates produced by catalytic mufflers. Although EPA studies have dismissed a health impact to the general public, bicyclists may have exposures different than the general public. A concern of more serious import is the health impact of significantly increasing numbers of diesel vehicles. A recent review of the health effects associated with diesel exhaust emissions concluded that no definitive judgment regarding diesel emissions could be made due to the lack of a broad-based community study or well-controlled investigation of a worker population (19).

Until further research is conducted on the health effects of bicyclist exposure to pollutants, no firm conclusions can be drawn.

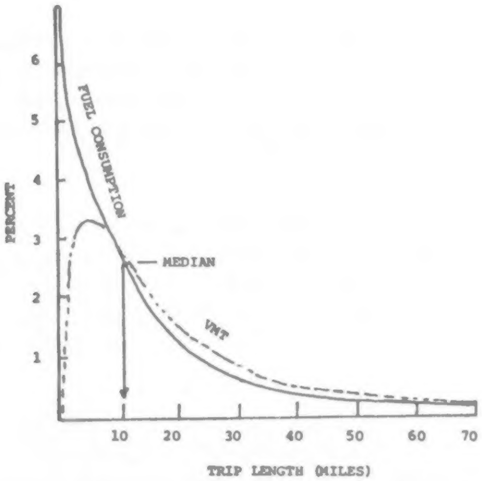
3.5 Calculation of Gasoline Savings

Some analyses of bicycle-related energy-saving potential underestimate the possible savings because the substantially higher consumption levels of cars on short trips in urban areas are not factored in.

Gasoline savings associated with bicycle strategies can be roughly approximated using VMT data, estimating modal shift from cars to bicycles, and utilizing data on average gasoline consumption for the local mix of automobiles. Just as low speeds and short trips result in increased CO and HC emissions, more gasoline is consumed for shorter trips. This relationship is shown in Figure 3-7.

Figure 3-7

DISTRIBUTION OF NATIONWIDE VMT AND FUEL CONSUMPTION



Source: T.C. Austin, K.H. Hellman, "Passenger Car Fuel Economy as Influenced by Trip Length", paper presented at the Automotive Engineering Congress, Detroit, February 1975.

A rough approximation of gasoline savings associated with bicycle strategy alternatives can be calculated using the following formula:

$$\frac{\Delta \text{ VMT}}{\text{Average MPG}} = \text{Gasoline Savings}$$

where Δ VMT = the reduction in VMT anticipated as a result of the bicycle strategy

Average MPG = an average figure for gasoline consumption based on the local vehicle fleet mix, average trip length diverted, and year of estimate

Factors for relative fuel economy by trip length are presented in Figure 3-8.

Figure 3-8

RELATIVE FUEL ECONOMY AND MEAN TRIP LENGTH

Mean Trip Length	Relative Fuel Economy
1/4 mi.	.10
1	.25
3	.45
4	.55
5	.60
6	.65

Source: T.C. Austin, K.H. Hellman, "Passenger Car Fuel Econmy as Influenced by Trip Length", paper presented at the Automotive Engineering Congress, Detroit, February, 1975.

We can use the hypothetical VMT reduction from Figure 3-4 to illustrate use of the formula. Hypothetical VMT reduction associated with the bicycle strategy was 28,900 VMT. If we assume that average gasoline consumption is 18 mpg for 1980 in our hypothetical locality, and average trip length displaced is 1.4 mi.[1], average gasoline consumption is roughly 5.4 mpg[1]. Therefore, gasoline savings would be roughly 5352 gallons per year. The dollar value of gasoline savings associated with bicycle strategies can then be calaculated by multiplying the gallons saved by the actual or estimated average price per gallon in the local area for the desired projection date[2].

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[1] Average bicycle trip length in a 1975 Census study (20).

On an aggregate level, Hirst (22) estimated that 1.8% of total urban automobile energy use could have been saved in 1971 if 10% of the urban auto travel conducted during daylight and in good weather for trips of under 6 miles was shifted to bicycles.

Actual gasoline consumption (and associated gasoline savings attributable to modal shift associated with bicycle programs) is dependent on a large number of variables. These variables include average speed of the automobile, range of speeds, frequency of major speed changes, frequency of minor speed changes, engine termperature at start-up, trip length, road surface, road curvature, grade, and ambient conditions (temperature, barometer, humidity, and wind) (21). Therefore, evaluation of bicycle strategy impacts should utilize local expert air quality and transportation staff and data, so that local gasoline savings estimates are as reliable as possible.

3.6 Economic and Health Impacts

3.6.1 Economic Impacts

Use of bicycle transportation in Davis, California is probably higher than in any other locality in the U.S. Several psychologists at the University of California's Davis campus have evaluated the effects of bicycle travel in Davis over a series of years. They concluded that the bicycle helped preserve the core area of the city as a viable shopping area since parking is not a serious obstacle to downtown shopping (23). They stated "Many business leaders in the community are strong proponents of bike riding, and admit that this is a matter of self-interest. The use of bicycles has meant that there are no parking meters in the city and the traffic situation at rush hours is tolerable" (24).

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[1] Fuel economy factor of approximately .30 x 18 mpg = 5.4 mpg.

[2] A useful source of data on current gasoline prices is the "Lundberg Letter", a weekly publication containing statistics on the oil industry published by Tele-Drop, Inc., P.O. Box 3996, N. Hollywood, CA 91609.

These same researchers also noted that the high schools and University were also able to set aside less land for parking due to the minimal space demands of bicycle parking and high levels of bicycle use.

The Elroy-Sparta trail, located in rural Wisconsin provides a dramatic example of economic effects of a regional recreation bicycle path. Built in 1967 at a total cost of $329,000, the fifty mile trail attracts 43,000 bicyclists annually. An estimated additional 3,000 bicyclists use the trail each year. The annual trade added to local community businesses has been estimated at $295,000, or a 7% growth factor for local travel business each year. The Wisconsin Department of Natural Resources, adding in a local multiplier effect, estimates the Trail brings an added $708,000 to the regional economy each year (25).

Bicycle facilities can increase real estate values, also. For example, real estate ads for houses in Lincoln, Massachusetts often note proximity to bicycle paths. The same phenomena has been noted in Seattle, where proximity to the Burke-Gilman Trail is often mentioned in real estate ads (26).

3.6.2 Health Benefits

Several major studies have established a correlation between regular exercise and good health (e.g., increased longevity), and at least one insurance company is now giving 10-25% reductions on its life insurance policies to non-smokers who have participated in non-static, aerobic exercise such as bicycling, swimming, or jogging for at least a year (27). Over 200 companies in the U.S. have recognized the financial benefits of physical fitness programs (28). These companies include AT & T, Chase Manhattan, ALCOA, IBM, Xerox, Weyerhauser, and Exxon[1] (28, 29). One study indicated a 27% reduction in absenteeism after a one year exercise program was initiated at a Goodyear plant in Sweden (27).

Ten nations have a lower death rate from circulatory disease than the U.S. (30). During 1978, the federal government spent $48 billion on health care but less than $2 billion on disease prevention and fitness promotion. Physicians have stressed the aerobic and exercise benefits of bicycling, including Boston's famous heart surgeon, Dr. Paul Dudley White. Another bicycling physician, Dr. Clifford Graves, considers bicycling superior to running, jogging, tennis, or golf because the knees and hips are not subjected to constant jarring or bumping (31). Cycling is also recommended for alleviating muscle injuries and leg soreness from other types of exercise such as running (32).

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[1] More information on physical fitness programs can be obtained from the American Association of Fitness Directors in Business and Industry, c/o President's Council on Physical Fitness and Sports, Washington, D.C.

Commuting to work can provide a reasonable level of aerobic exercise for some riders. As illustrated in Figure 3-9, cycling three times a week for a minimum of ten minutes at 60% of maximum heart rate intensity is suggested as a minimum aerobic program, after approval by a physician.

Figure 3-9

AEROBIC EXERCISE PRESCRIPTION

Factor	Low Fitness Level	Medium Fitness Level	High Fitness Level
Frequency (Days/Week)	3	3 or 4	5
Duration (Mins/Workout)	10-20	15-45	30-60
Intensity			
(% Max HR Range)	60-70	70-80	80-90
(% VO2 Max)*	50-60	60-70	80-90
Mode	Walk, Jog Swim, Cycle	Walk, Jog, Run Swim, Cycle	Jog, Run, Swim, Cycle

---

Source: "An Aerobics Approach", Bike World, July/August 1978.
* VO2 Max. - an individual's maximum oxygen uptake.

It would be desirable to quantify or estimate health benefits from bicycling strategies. Such benefits could take the form of public health benefits due to reduced auto emissions as well as benefits to individual riders due to increased exercise. Such benefits were not included in the examples given above due to measurement difficulties. In a national survey of studies on the health costs of air pollution covering studies published from 1967-1977, Stewart Herman concluded that the existing health effects studies "depended heavily on mathematical calculations rather than actual measurement" and "to date, no study has pulled together all the available data on air pollution and health effects in order to compile a systematic and comprehensive estimate of the health costs imposed by air pollution" (33).

3.7 Estimating Program Costs

Desired bicycle strategy benefits such as emission reductions must be weighted against program costs. The first step in estimating costs is to compute total annualized costs for each bicycle strategy. This requires estimating costs for each program component (e.g., bike parking racks, education programs), inflating the cost appropriately for future expenditures during the planning period, using a reasonable discount rate, and calculating the present value of all expenditures. Total costs can then be annualized.

Areas with bicycle programs already underway should already be familiar with these procedures. For areas which are unfamiliar with bicycle programs, illustrative comprehensive bicycle programs have been summarized in Figure 3-10. Relative program costs have been indicated as lower, medium, and higher. For areas unfamiliar with bicycle programs, some order-of-magnitude cost information has been included in Appendix C. However, given widely differing costs across the U.S., and variations in the inflation rate, it cannot be emphasized strongly enough that serious consideration of alternative bicycle program costs must depend on local and current cost data.

In addition to estimating the expenditures required to implement alternative bicycle strategies, other costs must be considered. These include changes in travel time and accidents.

The following cost equation was used by Everett (34) for estimating relative costs of various forms of transportation:

$$T = (a + pf) + D(b + pv)$$

where T = total annual cost of commuting by car or bicycle (dollars per year)

a = annual fixed costs of owning the vehicle(s) (dollars per year)

p = value of time (dollars per minute)

f = fixed time costs at terminals (minutes per year)

D = distance of travel during the year (miles per year)

b = vehicle operating costs (dollars per mile)

v = annual average speed (minutes per mile)

Figure 3-10

ILLUSTRATIVE COMPREHENSIVE BICYCLE STRATEGIES

COMPONENT	LOWER COST	MEDIUM COST	HIGHER COST
INSTITUTIONAL SUPPORT	Staff: Use of vacant unfunded position for metropolitan area coordinator Data: Incorporation of bicycle questions into existing data collection efforts	Staff: Funding of part-time coordinator at metropolitan and state levels Data: Limited special studies	Staff: Full time metropolitan and state coordinators Data: Detailed special studies
BICYCLE FACILITY IMPROVEMENTS	Printing and Distribution of Bicycle Route Maps Routine Shoulder Upgrading Grate Strapping	Bikeways: Class I - 10 miles Class II - 20 miles Parallel Grate Replacement Bicycle-actuated Signal - One	Bikeways: Class I - 30 miles Class II - 100 miles Class III - 10 miles Parallel Grate Replacement Bicycle-actuated Signal - Two Construction one Bridge Lane
INTERMODAL LINKS	Bus Rack - 2	Bus Racks - 3 Bike Racks at Transit Stations - 30	Bus Racks - 5 Bike Racks at Transit Stations - 30 Bike Lockers at Transit Stations - 50
PARKING	Bike Racks at Public Buildings - 30	Bike Racks at Public Buildings and Major Activity Centers-60	Bike Racks and Lockers at Public Buildings and Major Shopping Areas - 50 lockers, 60 racks
MAINTENANCE	Use of Existing Crews and Equipment for Periodic Sweeping of Mapped Routes	Part-time funding of Bike Facility Maintenance	Part-time funding of Bike Facility Maintenance Crew Purchase of Special Sweeper
EMPLOYER PROGRAMS	SEE MARKETING SECTION		
EDUCATION	Add Section to Driver's Handbook	Teacher Training Sessions for Elementary Teachers	Use of Certified Instructor for Elementary Student Sessions
ENFORCEMENT	Dissemination of Rules of the Road to Schools	Dissemination of Rules of the Road to Schools Police Training	Dissemination of Rules of the Road to Schools Part-time Bicycle Policeman
MARKETING	Use of Public Service TV and Radio Spots	Printing and Distribution of 200 Information Kits to Employers	Printing and Distribution of Information Kits to all large Employers / Executive Briefings Paid Radio and TV Spots

Unfortunately, many bicycle accidents are unreported, particularly those which do not involve a motor vehicle. Furthermore, bicycle accidents not involving a motor vehicle appear to comprise the major proportion of all bicycle accidents. For example, analysis of data from the Consumer Products Safety Commission's National Electronic Injury Surveillance System (NEISS) indicates that 18% of all bicycle-related fatalities and 94.5% of all bicycle-related injuries were the result of non-motor vehicle accidents (35). Using the NEISS data, Dr. K. Cross estimates that about 1,000 fatalities and 80,000 injuries result from bicycle/motor vehicle accidents each year, and 220 fatalities and 1,374,000 serious injuries result from non-motor vehicle accidents each year. The type of accident associated with non-motor vehicle conflicts is indicated in Figure 3-11 which indicates that falling or colliding with a fixed object is the major cause of this type of accident. On the local level, survey data will provide the most accurate data on baseline accident rates by type, and on accident costs.

Figure 3-11

RELATIVE FREQUENCY OF TYPES OF NMV ACCIDENTS

		TYPES OF NMV ACCIDENTS		
DESCRIPTION OF SAMPLE AND SOURCE	NUMBER OF ACCIDENTS IN SAMPLE	BICYCLE-BICYCLE	BICYCLE-PEDESTRIAN	COLLISION WITH FIXED OBJECT OR FALLING
SURVEY OF GENERAL POPULATION IN THE STATE OF TENNESSEE (Barton-Aschman Associates, 1974b)	47	11%	0%	89%
SURVEY OF GENERAL POPULATION IN THE STATE OF PENNSYLVANIA (Barton-Aschman Associates, 1975)	98	9%	1%	90%
SURVEY OF A SAMPLE OF GRADE-SCHOOL CHILDREN [AGES 7-13] IN 170 SCHOOLS IN 110 CITIES IN 37 STATES (Chlapecka et al., 1975)	5601	11%	1%	88%
ALL ACCIDENTS TREATED IN THE STUDENT HEALTH FACILITY AT THE UNIVERSITY OF CALIFORNIA, SANTA BARBARA, DURING THE PERIOD BETWEEN 1971 AND 1976 (Chung, 1976)	794	42%	6%	52%

Source: Kenneth D. Cross, Bicycle-Safety Education, AAA Foundation for Traffic Safety, Falls Church, Va., Aug. 1978, p. 23.

3.8 Relative Air Quality Impacts of Bicycle Strategies in Combination with, and Compared with, Other Transportation Measures

Use of several of the transportation measures in conjunction with bicycle strategies can increase the positive air quality effects of bicycle programs. Measures to increase transit patronage can benefit bicycle programs if intermodal facilities, such as transit station parking facilities, are provided. Measures to restrict traffic, such as limiting hours or location of travel[1], may increase the attractiveness of bicycle travel. Transportation pricing measures, such as a parking surcharge, will increase the individual savings associated with bicycle use. Long-term measures to reduce the need to travel, such as zoning for more compact land use development, should decrease trip length, thereby increasing the short trip VMT potential for modal shift to bicycles. Finally, gasoline restrictions--whether resulting from a transportation measure or through other circumstances--may have the greatest effect on increased bicycle use. For example, Sunday or weekend gas station closings may make the bicycle a more attractive alternative for recreational and utility shopping trips.

Information on estimated air quality impacts of major transportation measures will be available after all the Section 108(f) information documents have been released by EPA. In the meantime, air pollution and energy reduction effects of alternative transportation measures in Figure 3-12 can be used as a rough indication of potential effects.

Bicycle measures compliment many of the other transportation measures. For example, transit patronage may be improved if bicycle parking facilities are provided at transit stations, or if bicycles can be carried on busses or trains. An example of this phenomena is the San Diego bus/bike rack demonstration where bus patronage increased due to bicycle rider use of the new service (see Section 2).

Measures to restrict auto travel, including private car restrictions, on-street parking controls and road pricing to discourage single occupancy auto trips, may make bicycle travel relatively more attractive for some trips. Auto restrictions may have an additional indirect effect on bicycle measure effectiveness. To the extent that auto restrictions increase the demand for transit beyond capacity, it may increase bicycle trips. For example, commuting to work by bicycle during the summer months may appear more attractive to some people than standing in a hot, overcrowded bus or train, or paying extremely high fees for use of a car.

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[1] For instance, closing a parkway to vehicular travel on weekends. New York City, for example, has closed a major road in Central Park during summer weekends.

Figure 3-12

RELATIVE IMPACTS OF BICYCLING AND OTHER TRANSPORTATION MEASURES

Action Group	Action	Regional Energy Reduction (%)	
			Air Pollution
1. Measures to Improve Flow of High Occupancy Vehicles	Bus-actuated signals	0 - 0.5	Decrease
	Bus-only lanes on city streets	0 - 2.0	Decrease
	Reserved freeway bus or bus/carpool lanes and ramps	1.0 - 3.0	Decrease
	Bus priority regulations at intersections	0 - 0.5	Decrease
2. Measures to Improve Total Vehicular Traffic Flow	Improved signal systems	1.0 - 4.0	Decrease
	One-way streets, reversible lanes, no on-street parking	1.0 - 4.0	Decrease
	Eliminate unnecessary traffic control devices	0 - 2.0	Decrease
	Widening intersection	0 - 1.0	Decrease
	Driver advisory system	0 - 0.5	Decrease
	Ramp metering, freeway surveillance, driver advisory display	0 - 1.0	Decrease
	Staggered work hours	0	Decrease
3. Measures to Increase Car and Van Occupancy	Carpool matching programs	3.0 - 6.0	Decrease
	Carpool public information	2.0 - 4.0	Decrease
	Carpool incentives	4.0 - 6.0	Decrease
	Neighborhood ride sharing	0 - 1.0	Decrease
4. Measures to Increase Transit Patronage	Service improvements	1.0 - 3.0	Decrease
	Fare reductions	4.0 - 6.0	Decrease
	Traffic-related incentives	1.0 - 5.0	Decrease
	Park/ride with express bus service	0.5 - 2.5	Decrease
	Demand-responsive service	0 - 1.0	Decrease
5. Measures to Encourage Walk and Bicycle Modes	Pedestrian malls	0.5 - 2.5	Decrease
	Second level sidewalks	0 - 0.5	Decrease
	Bikeway system	0.5 - 2.0	Decrease
	Bicycle storage facilities	0 - 1.0	Decrease
	Pedestrian-actuated signals	0 - 0.5	NE
	Bicycle priority regulations at intersections	0 - 0.5	NE
6. Measures to Improve the Efficiency of Taxi Service and Goods Movement	Improve efficiency of taxi service	0 - 2.0	Decrease
	Improve efficiency of urban goods movement	0 - 1.5	Decrease

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Figure 3-12, continued

7. Measures to Restrict Traffic	Auto-free or traffic limited zones	0.5 - 2.5	Decrease
	Limiting hours or location of travel	0 - 3.0	Decrease
	Limiting freeway usage	0 - 1.0	Decrease
8. Transportation Pricing Measures	Bridges and highway tolls	1.0 - 5.0	Decrease
	Congestion tolls and road cordon tolls	1.0 - 5.0	Decrease
	Increased parking costs	0.5 - 3.0	Decrease
	Fuel tax	2.0 - 6.0	Decrease
	Mileage tax	2.0 - 6.0	Decrease
	Vehicle-related fees	2.0 - 10.0	Decrease
9. Measures to Reduce the Need to Travel	Four-day work week	1.0 - 6.0	Increase/ Decrease
	Zoning	1.0 - 10.0	Decrease
	Home goods delivery	0 - 1.0	Decrease
	Communications substitutes	0 - 1.0	Decrease
10. Energy Restriction Measures	Gas rationing without transferable coupons	10.0 - 25.0	Decrease
	Gas rationing with transferable coupons	10.0 - 25.0	Decrease
	Restriction of quantity of sales on a geographic basis	5.0 - 20.0	Decrease
	Ban on Sunday and/or Saturday gas sales	2.0 - 10.0	Decrease
	Reduced speed limits	0 - 2.0	Decrease

SYMBOL: NE - No Effect

Source: Alan M. Voorhees and Associates

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SECTION 4: PLANNING AND IMPLEMENTATION

4.0 Introduction

The planning and implementation process in many of most active bicycle programs is characterized by:

- strong legislation and political support
- clear assignment of lead responsibility, e.g., to a bicycle coordinator
- cooperation and coordination among supporting agencies
- availability of funding for the bicycle program.

Each of these factors is discussed in more detail in this section.

4.1 Legislation and Political Support

Many of the strongest bicycle programs in the U.S. are supported by good state and local legislation. In turn, political support is needed both for passage of the initial enabling legislation, and during the bicycle program implementation process as program funding approvals are needed. Both legislation and political support are discussed in this section, including the following types of legislation:

- enabling legislation to establish clearly and maintain a program at the state and local levels with staff and a bicycle coordinator to implement the legislation
- consistent laws governing bicycle operation
- legislation governing bicycle facilities such as that contained in a zoning ordinance
- enabling legislation for statewide bicycle registration
- inclusion of developer guidelines for bikeway facility construction in the subdivision ordinance
- legislative adoption of bicycle plans
- laws or regulations governing use of bicycle facilities by mopeds, skateboards and skates

4.1.1 Model Ordinance or Act Authorizing a Program of Bicycle and Bikeway Planning and Implementation

The most important elements of any legislation establishing a bicycle program include:

- a clear statement of the major elements to be considered and included in a comprehensive bicycle program
- reasons justifying a bicycle program
- definitions
- appointment of an agency to administer the program and a bicycle coordinator
- authorization of a minimum funding level for the bicycle program

Some of the strongest bicycle programs in the U.S. have such enabling legislation, including the states of California and North Carolina, and the City of Madison, Wisconsin. A model State Act/ City Ordinance has been developed for this document, based on a review of relevant statutes and legal authority for bicycle programs, and is contained in Appendix D. The Model Ordinance/Act embodies the concepts and proposals set forth in earlier sections of this report. Before its adoption by a state or local government, local legal counsel should be consulted to insure conformity with the existing laws in the jurisdiction.

4.1.2 Consistent Laws Governing Bicycle Operation

Many states have confusing, inconsistent, or outdated motor vehicle codes pertaining to bicycles. A number of recent studies have recommended review and evaluation of local vehicle laws (1-4). One criticism of local bicycle laws is that there is needless inconsistency between jurisdictions and between states. To that end, the National Committee on Uniform Traffic Laws and Ordinances Uniform Vehicle Code, as it pertains to bicycles, may be used as an initial model. The bicycle-related portions have been reproduced in Appendix D.

The provisions of the Uniform Vehicle Code are generally recommended, subject to the advice of local legal counsel, with the exception of Section 11-1205(c) on mandatory bicycle path use. This section is controversial, partly because of inadequate maintenance on some bicycle paths, and/or poor initial design. Bicycle riders have argued that some paths actually increase accident hazards, compared to roadway riding, and substantially decrease speed, an important consideration for bicycle commuters. In 1979, the Subcommittee on Operation recommended to the National Committee on Uniform Traffic Laws and Ordinances that mandatory use of bike paths be dropped. A majority of those at the national meeting, and in a mail ballot, approved deletion. The mandatory provision is still part of the Code because the required 60% vote on a mailout ballot was not realized. However, several states have already deleted similar provisions. Revocation of the mandatory bicycle path riding provision in Michigan is being discussed (5), and similar laws have already been repealed in Maryland, California, and Connecticut (6). Seattle deleted reference to the mandatory path rule during a recent revision of the Traffic Code, and similar changes at the State level were proposed in the State Legislature, although not enacted (7) during the 1978-79 session.

4.1.3 Bicycle Facility Legislation

Several types of legislation fall into the category of bicycle facility legislation, including construction standards and zoning requirements for bicycle parking. Several areas have developed their own construction codes, such as the CALTRANS standards mentioned in Section 2.

Zoning for bicycle facilities is a new area which has only recently been tried. Such zoning requires that a mimimum number of bicycle parking facilities be constructed for different types of land uses. The Palo Alto zoning ordinance is an outstanding example and a summary has been included in Appendix D. (A copy of the ordinance may be obtained from the City of Palo Alto, California).

Other legislative incentives for bicycle construction might include a specific set-aside of highway funds for bicycle facilities, construction of bikepaths or wide shoulders when new highways are constructed, or maintenance of existing bikeways along state or local routes as in the States of Oregon and Washington.

4.1.4 Statewide Bicycle Registration

Enabling legislation for statewide bicycle registration can be very beneficial to bicycle owners. Two states--California and Minnesota--have enacted legislation at the State level. The California legislation permits municipalities to adopt local bicycle registration ordinances, determine its own registration system and keep the fees to cover costs and bicycle facility programs. No state funds were allocated to cover costs, but authorities estimate an 85% participation rate by cities and counties.

The Minnesota Legislature passed legislation in 1976 authorizing operation of a statewide bicycle registration program[1]. License data is computerized, including the serial number, brand name, frame size, assigned license number and owner's name and address. A major advantage of this system is access by local law enforcement agencies throughout the state to the stolen articles file within the Minnesota Crime Information System (MINCIS). The approximately 52 local licensing programs were cancelled by the authorizing legislation. Since the inception of operation in 1977, 75-80 stolen bicycles have been identified.

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[1] For more detailed descriptions, see M.D. Connelly and E.R. Lofton, North Carolina Bicycle Registration Study (Research Triangle Park, N.C.: RTI), November 15, 1978.

Statewide bicycle registration can generate valuable data to be used in assessing the magnitude of bicycle ownership. Registration can also assist in notifying relatives of injured bicyclists--especially children--who are seriously injured and are not carrying identification.

4.1.5 Developer Guidelines

Inclusion of developer guidelines for bikeway development in the local subdivision ordinance can be an impetus to additional and better facilities. The following elements might be considered when drawing up such guidelines:

General Recommendations

- New development plans to coordinate road and recreation plans with any existing or proposed bikeway plan
- Bikeways within new developments designed and constructed according to accepted standards of width, curve radius, grades, stopping sight distances, draininge, vertical clearance, signing, pavement materials, etc.
- Specifically designed bicycle parking facilities located at all public bicycle destinations within new developments.

Street Design Recommendations

- Transportation corridors within new developments to allow the necessary right-of-way to permit the construction of bikeways
- Streets related to the topography of the area so as to reduce unreasonable grades for bicycles
- Where appropriate, developer allowance of necessary width and grading to construct bicycle/pedestrian underpasses beneath major bicycle/pedestrian access barriers
- Where appropriate, connections from on-street bikeways provided at cul-de-sac locations

- Where on or off-street bikeways intersect a major street, intersection design utilizing the best available data on safe design accident and engineering
- Clear sight triangles provided at all intersections of two or more streets
- Approved bikeway signing provided at all decision points and warning locations along a bikeway for bicyclists

Recreation/Open Space Area Design Recommendations

- Existing waterways or drainage courses as well as other recreation corridors designed to allow the construction of continuous bikeway facilities
- Recreation facilities within new developments as well as recreation areas adjacent to the development connected by bikeways
- Specifically designed and approved bicycle parking facilities provided at park, recreation and open space areas

4.1.6 Legislative Adoption of Bicycle Plans with Commitment to Implement

Many bicycle program plans have been prepared but not implemented. Because lack of implementation has been a problem with many transportation plans, EPA requires that all transportation measures in the SIP, including bicycle measures, be backed by the commitment to implement. Bicycle strategies should, therefore, have legislative adoption to ensure that political support exists for implementation.

Often, the state highway or transportation commission is the entity which formally adopts specific bikeway plans and project improvements. Local adoption by the city council is common on the local level. Davis and Palo Alto (California) and Seattle (Washington) are examples of local areas which have adopted plans.

Regional bicycle plans usually must be formally adopted by the agency that commissions their preparation. Often this is the metropolitan planning organization. Local and state adoption of this plan is mandatory for its implementation.

4.1.7 Political Support

Obviously, legislative support is critical for passage of the legal measures discussed in the previous sections, and for program funding. An example of the "crushing defeats" which can result if such political support is lacking is recounted by Charles Floyd (8). A bikeway system for Clarke County, Georgia was supported by a broad range of organizations, including the County Commissioners, the State Highway Department, and the State Department of Transportation. However, the project was killed when the State legislature turned down the Transportation Commissioner's request for a state share of the matching funds required for local bikeway projects financed under the Federal Highway Act of 1973.

Methods of getting legislative support for bicycle programs include:

- working with one or more legislators who are already interested in bicycle transportation
- ensuring that legislators are aware of interest in bicycle programs, particularly constituent interest
- electing legislators who will support bicycle transportation and any necessary bicycle programs
- providing legislators with information on bicycle transportation, and generating support

Strong support by even one legislator can be instrumental in the development of a bicycle program. For example, former Massachusetts State Senator William Saltonstall, whose daughter was killed in a bicycle accident, has provided the political leadership in Massachusetts for an important piece of legislation, bicycle rules of the road. He also supported a special bicycle facilities section of a recent State Transportation Bond Issue providing $2 million in matching funds and grants for bicycle projects.

In addition to personal interest, political support may result from constituent concern and/or pressure. If sufficient citizen support exists, pro-bicycle candidates may be elected. The Davis, California case study in Section 5 provides an example of this process.

Finally legislative support can be increased through the provision of information and education. A bicycle coordinator can provide leadership for such efforts. For example, the state bicycle coordinator in Michigan appoints legislators to her bicycle advisory committee. As a result, bicycle proposals are developed with the cooperation of legislators, and her bicycle proposals have strong legislative advocates. She has also developed an on-road training program for officials, including legislators, so that they will experience first-hand the actual problems of bicycle riding in Michigan.

4.2 Bicycle Coordinators and Advisory Committees

Highly motivated bicycle coordinators at the local, regional, and state levels can make the difference between implementation of a strong bicycle program or development of just another plan for the shelf. Similarly, bicycle advisory committees have been useful in providing political support for bicycle programs, as well as providing substantive input to the planning process.

4.2.1 Bicycle Coordinator

Every bicycle strategy included in a State Implementation Plan should include a commitment for the appointment of a bicycle coordinator at the state and local levels. Bicycle coordinators have been instrumental in the planning and implementation of many strong bicycle programs (see the case studies in Section 5 for examples), and can provide the leadership needed to coordinate the many programs and individuals potentially involved in a comprehensive bicycle program.

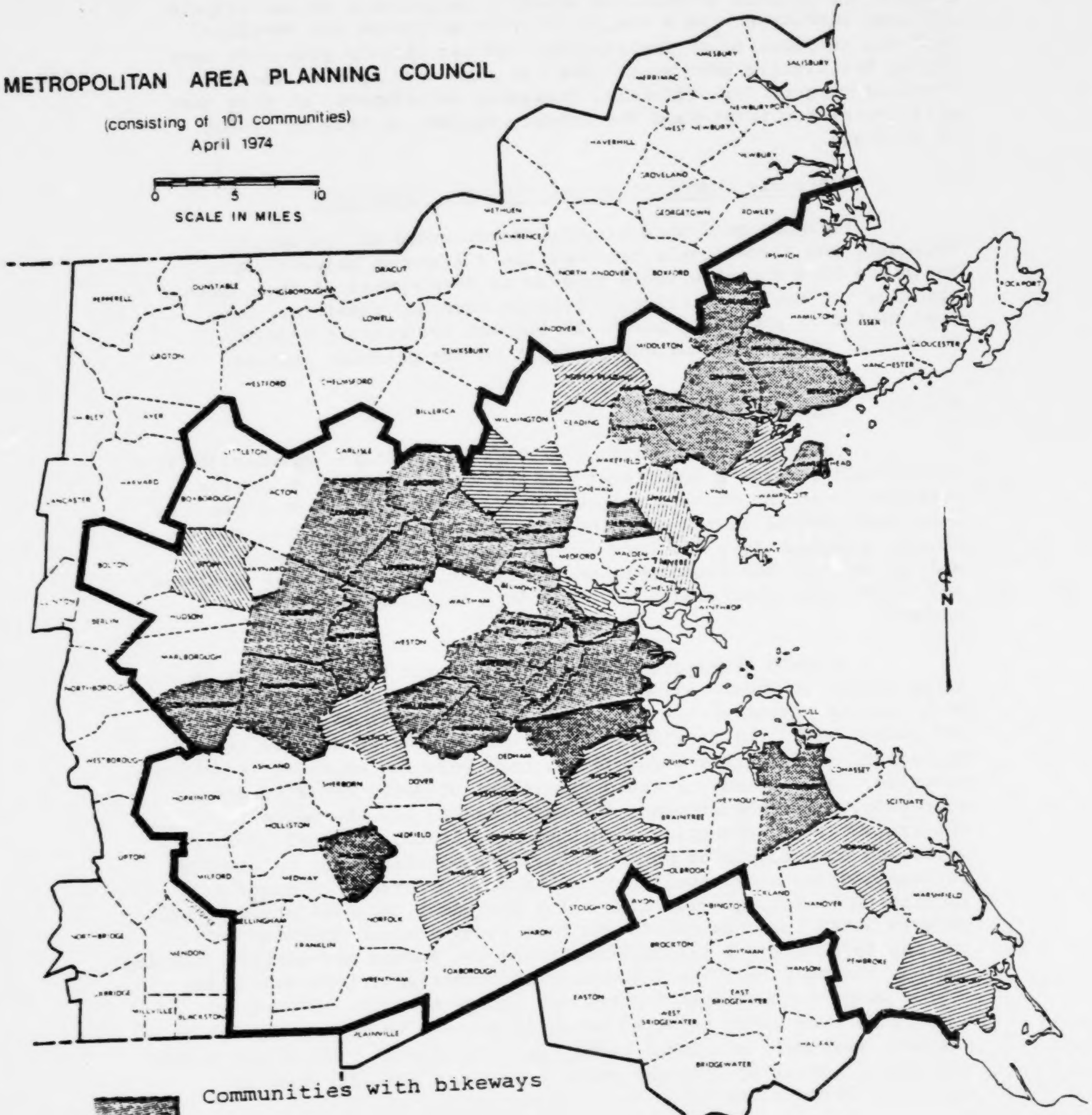
Bicycle transportation strategies must be carried out by a large number of organizations. For example, bicycle measures involve such diverse organizations as the local departments of transportation and public works for facilities construction, the local mass transit organizations for inter-modal links, employers for employer incentive programs, schools and the state Department of Motor Vehicles for education, police departments for enforcement, and the media for encouragement and education. Furthermore, state, regional, county, city, and town levels of many of these organizations may be involved in implementing a metropolitan-wide bicycle program. An example showing the major agencies with which the North Carolina state bicycle program works is contained in the case study section (Section 5-3). The map in Figure 4-1 illustrates, using the Boston air quality planning region, the many individual communities potentially involved in the Boston bicycle transportation measure implementation. Figure 4-2 summarizes some major agencies which often have to be coordinated on a state, regional, and local level, and the helpful role a coordinator can play in ensuring that the various agencies mutually support increased bicycle use.

At the state level, a bicycle coordinator can concentrate on state-wide issues, such as linking of metropolitan facilities, improvement of the motor vehicle/bicycle traffic laws, incorporation of bicycle safety education into the state model or core curriculum, information dissemination, and provision of assistance to metropolitan

Reproduced from best available copy.

Figure 4-1

Communities in the Boston Transportation Planning District

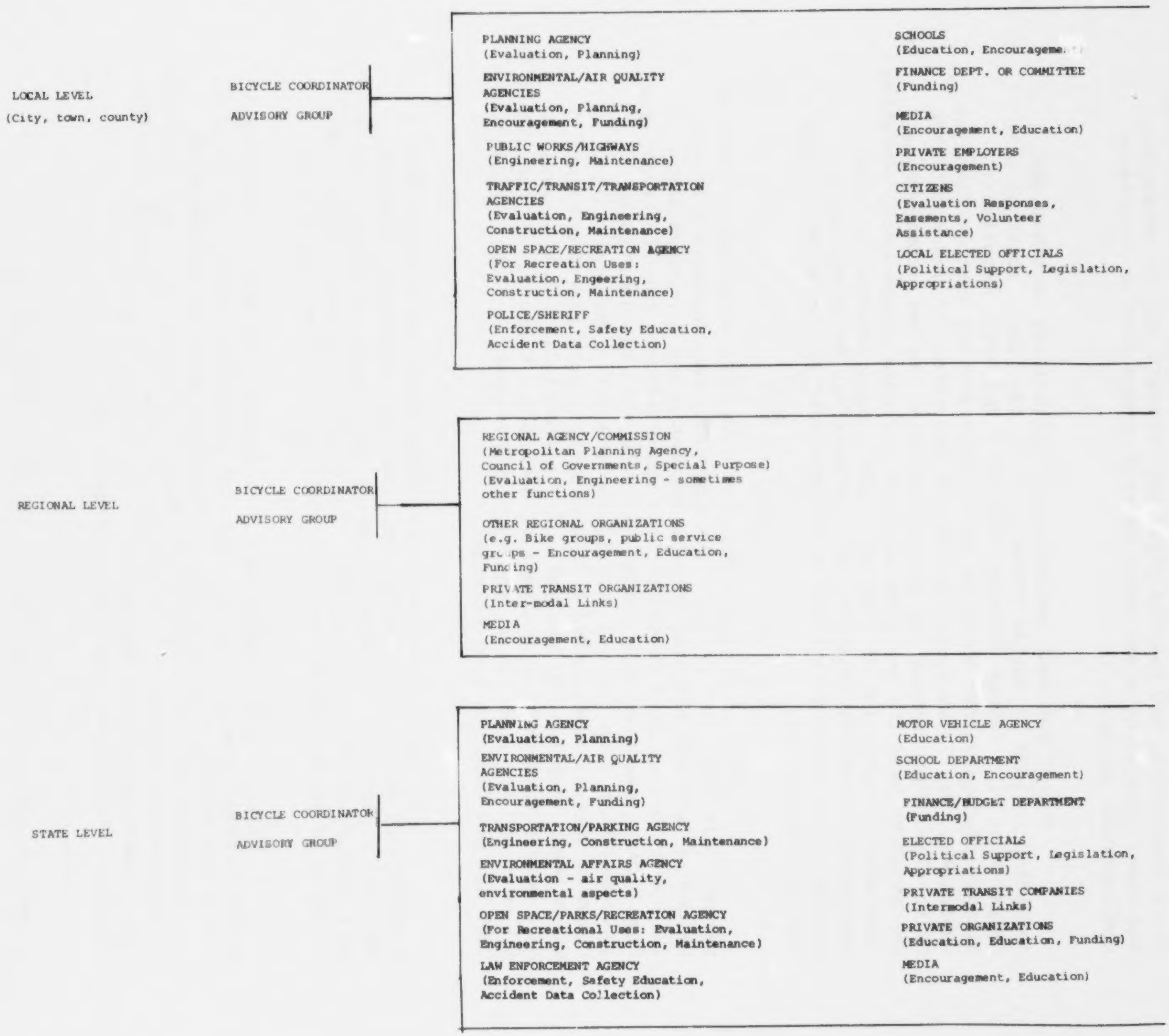

METROPOLITAN AREA PLANNING COUNCIL
(consisting of 101 communities)
April 1974
0 5 10
SCALE IN MILES
N
AMESBURY
SALISBURY
MERRIMAC
NEWBURYPORT
WEST NEWBURY
HAVERHILL
NEWBURY
GROVELAND
GEORGETOWN
ROWLEY
METHUEN
LAWRENCE
NORTH ANDOVER
BOXFORD
IPSWICH
DRACUT
DUNSTABLE
PEPPERELL
LOWELL
ANDOVER
HAMILTON
ESSEX
ROCKPORT
GROTON
TEWKSBURY
MIDDLETON
GLOUCESTER
MANCHESTER
WESTFORD
CHELMSFORD
BILLERICA
WILMINGTON
READING
AYER
LITTLETON
CARLISLE
WAKEFIELD
HARVARD
ACTON
BOXBOROUGH
LANCASTER
LYNN
BOLTON
MEDFORD
MALDEN
REVERE
CHELSEA
HUDSON
BERLIN
WALTHAM
WINTHROP
MARLBOROUGH
WESTON
NORTHBOROUGH
WESTBOROUGH
ASHLAND
DEDHAM
HULL
SHERBORN
DOVER
QUINCY
COHASSET
HOPKINTON
WESTWOOD
SCITUATE
HOLLISTON
BRAINTREE
MEDFIELD
UPTON
MILFORD
MEDWAY
HOLBROOK
MARSHFIELD
HANOVER
ROCKLAND
ABINGTON
STOUGHTON
AVON
BELLINGHAM
NORFOLK
SHARON
NORTHBRIDGE
MENDON
FRANKLIN
BROCKTON
WHITMAN
HANSON
PEMBROKE
FOXBOROUGH
WRENTHAM
EAST BRIDGEWATER
EASTON
WEST BRIDGEWATER
MILLVILLE
BLACKSTONE
PLAINVILLE
HALIFAX
BRIDGEWATER

▩ Communities with bikeways

▨ Communities with proposals

Figure 4-2

BICYCLE COORDINATORS AT LOCAL, REGIONAL AND STATE LEVELS



LOCAL LEVEL
(City, town, county)

BICYCLE COORDINATOR
ADVISORY GROUP

- PLANNING AGENCY (Evaluation, Planning)
- ENVIRONMENTAL/AIR QUALITY AGENCIES (Evaluation, Planning, Encouragement, Funding)
- PUBLIC WORKS/HIGHWAYS (Engineering, Maintenance)
- TRAFFIC/TRANSIT/TRANSPORTATION AGENCIES (Evaluation, Engineering, Construction, Maintenance)
- OPEN SPACE/RECREATION AGENCY (For Recreation Uses: Evaluation, Engeering, Construction, Maintenance)
- POLICE/SHERIFF (Enforcement, Safety Education, Accident Data Collection)
- SCHOOLS (Education, Encourageme
- FINANCE DEPT. OR COMMITTEE (Funding)
- MEDIA (Encouragement, Education)
- PRIVATE EMPLOYERS (Encouragement)
- CITIZENS (Evaluation Responses, Easements, Volunteer Assistance)
- LOCAL ELECTED OFFICIALS (Political Support, Legislation, Appropriations)

REGIONAL LEVEL

BICYCLE COORDINATOR
ADVISORY GROUP

- REGIONAL AGENCY/COMMISSION (Metropolitan Planning Agency, Council of Governments, Special Purpose) (Evaluation, Engineering - sometimes other functions)
- OTHER REGIONAL ORGANIZATIONS (e.g. Bike groups, public service groups - Encouragement, Education, Funding)
- PRIVATE TRANSIT ORGANIZATIONS (Inter-modal Links)
- MEDIA (Encouragement, Education)

STATE LEVEL

BICYCLE COORDINATOR
ADVISORY GROUP

- PLANNING AGENCY (Evaluation, Planning)
- ENVIRONMENTAL/AIR QUALITY AGENCIES (Evaluation, Planning, Encouragement, Funding)
- TRANSPORTATION/PARKING AGENCY (Engineering, Construction, Maintenance)
- ENVIRONMENTAL AFFAIRS AGENCY (Evaluation - air quality, environmental aspects)
- OPEN SPACE/PARKS/RECREATION AGENCY (For Recreational Uses: Evaluation, Engineering, Construction, Maintenance)
- LAW ENFORCEMENT AGENCY (Enforcement, Safety Education, Accident Data Collection)
- MOTOR VEHICLE AGENCY (Education)
- SCHOOL DEPARTMENT (Education, Encouragement)
- FINANCE/BUDGET DEPARTMENT (Funding)
- ELECTED OFFICIALS (Political Support, Legislation, Appropriations)
- PRIVATE TRANSIT COMPANIES (Intermodal Links)
- PRIVATE ORGANIZATIONS (Education, Education, Funding)
- MEDIA (Encouragement, Education)

area coordinators and localities. In addition to media contacts, the coordinator may need to work with the planning, transportation, environmental affairs, education, open space/parks/recreation, law enforcement, finance/budget, and motor vehicle departments within the state government, and elected officials, private transit companies, and other interested state-level private groups such as bicycle or environmental groups.

One of the most comprehensive state-level programs was initiated in 1974 by Curtis Yates in North Carolina. Starting with preparation of a report entitled "Bikeways for North Carolina--Bicycle Prerequisites" which he wrote while working for the Planning Department, Mr. Yates proposed that the Department of Transportation be the lead state agency for bicycle matters. He was subsequently appointed to head the new program which includes enforcement, education (including preparation of a bicycle safety rodeo manual, low cost demonstration safety programs, and a course for adult cyclists), bicycle route mapping, a study of bicycle user characteristics, and facility design (9).

A number of regional agencies have bike coordinators such as Boston, Baltimore, and Denver. For example, the coordinator at the Baltimore Regional Planning Council is continuing a program begun in the early 1970s. As a result of this early effort, bicycle transportation control measures were included in the 1973 Maryland State Implementation Plan for air quality improvement. The Regional Planning Council coordinated a five-county bicycle planning effort which began with a local analysis of the feasibility of bikeways. Each county undertook an analysis of demand for Class I, II, and III bikeways and for curb lanes, and each put together a plan. Implementation has now begun in some counties.

Like the regional agencies, many local coordinators have concentrated on physical facilities. Madison, Wisconsin, however, employed a part-time coordinator, using CETA funds, to follow through on a variety of bicycle programs. The coordinator worked out so well the city is attempting to set up a full-time coordinator position.

Bicycle coordinators may be volunteers in smaller localities within metropolitan areas. The towns of Lexington, Acton, and Lincoln within the Boston, Massachusetts metropolitan area are all examples of localities which have undertaken bicycle programs under the direction of volunteer coordinators. Larger cities generally have paid coordinators. Examples include Washington, D.C.: Seattle, Washington; Portland, Oregon; and Green Bay, Wisconsin (10).

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[1] A program administered by the U.S. Department of Labor.

4.2.2 Bicycle Advisory Committee

A Bicycle Advisory Committee is an effective and widely-utilized method of developing both high-level and grass-roots support for a bicycle program. Such committees often include elected officials, media representatives, and delegates from local transportation, school district, planning, and parks departments. Representatives of bicycling organizations and other interested groups are also often represented to involve the public in the planning and implementation process. Examples include advisory committees at the state level for both the Michigan and North Carolina bicycle programs.

4.3 Supporting Agencies: Program Coordination and Funding

To ensure a cohesive bicycle program, and to utilize implementation funding provided by other agencies, the bicycle coordinator or official responsible for bicycle measures should work closely with other interested agencies. Planning funds for this purpose are available through EPA's Section 175 Program.[1]

Inclusion of a bicycle strategy in the SIP and transportation measures is only the first step in the successful implementation of a bicycle measure. Bicycle measures in the SIP must be included in the regular transportation planning and implementation programs. These programs are discussed in more detail in the following section. Coordination with other agencies is equally important for other types of bicycle measures.

This section begins with a discussion of Federal programs. A summary of potential Federal funding sources is contained in Appendix E. Programs at the state, regional and local levels are discussed next. The section concludes with potential sources of private assistance. A list of major agencies and programs is contained in Figure 4-3.

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[1] See the 1978 Federal Register notice, p. 60215.

Figure 4-3

SUMMARY OF PROGRAMS

SOURCE

FEDERAL[1]

- EPA: Section 175, Urban Air Quality Planning Grants
  - Section 201, Wastewater Treatment Grants
- DOT: Federal Aid Highway Funds (Federal Aid Highway Program Manual, 6-1-1-1)
  - FHWA Section 217 of Title 23
  - UMTA TIP
  - NHTSA Section 402
  - Section 141 (c)
- HUD: Section 701 Urban Planning
  - Community Development Block Grants
- INTERIOR: HCRS Land & Water Cons. Fund
  - Historic Preservation Funds
- DOE: Appropriate Technology Small Grants Program
- COMMERCE: EDA Public Works Program
  - Urban Policy Incentives
- DOL: Title II, CETA
- HEW: Title IV Elem. & Sec. Ed. Act, Section "C"
- NAT'L ENDOWMENT FOR THE ARTS: Livable Cities Grants
  - Design, Communications & Res. Prog.

REGIONAL

- Metropolitan Planning Organizations
- Special Purpose Regional Service Districts

STATE AND LOCAL PUBLIC

- Local Departments (e.g. Transportation, Education, Law Enforcement)
- Bond Issues
- Capital Improvement Budget

PRIVATE

- Land Donations
- Employers and Businesses
- Community Organizations

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[1] See Appendix E for more information on programs.

4.3.1 U.S. Department of Transportation (DOT) Programs

Coordination of bicycle transportation planning for air quality purposes with the local transportation planning process is particularly important for several reasons. First, DOT has developed and funded an extensive transportation planning process in urban areas, which can provide valuable expertise and assistance. Second, in order to receive DOT and some EPA planning and implementation funds, bicycle activities must be included in the DOT transportation planning process and mandated documents such as the UPWP (Unified Planning Work Program).

In urban areas over 50,000 population, the U.S. Department of Transportation cannot approve federal planning and construction funds unless a comprehensive transportation planning process by a Metropolitan Planning Organization (MPO) is in effect. The planning process, known as the "3C" process, must be "a continuing, comprehensive transportation planning process carried on cooperatively by States and local communities."

A number of program documents must be produced during the 3C process, including a Unified Planning Work Program (UPWP), a Prospectus, both long-range and systems management Transportation Plans, a Transportation Improvement Program (TIP) for a 3-5 year period, and an annual element of the TIP. The Unified Work Program describes all planning activity to take place over the next year or two, and includes the costs and timing for each planning activity. The Prospectus describes the MPO, and how it will meet the 3C requirements. The Transportation Plan long-range element describes the long-range transportation policy for the area. The TSM (Transportation Systems Management Element) describes how existing facilities can be utilized more efficiently. The 3-5 year Transportation Improvement Program is a mid-range planning document which describes projects planned for implementation during this period. Finally, and most importantly, the Annual Element of the Transportation Improvement Program lists specific projects desired for implementation during the next year. This list is included in the state "Program of Projects" for annual submission to the U.S. Dept. of Transportation for funding approval.[1]

At the direction of the President of the U.S., an explicit procedure has been set up between EPA and DOT to reduce potentially duplicative, overlapping, and inconsistent activities at the state and local level. These procedures are contained in a Memorandum of Understanding and in Planning Guidelines (11, 12). The relationship of the EPA/DOT air quality programs, and the DOT-assisted transportation programs is illustrated in Figure 4-4.

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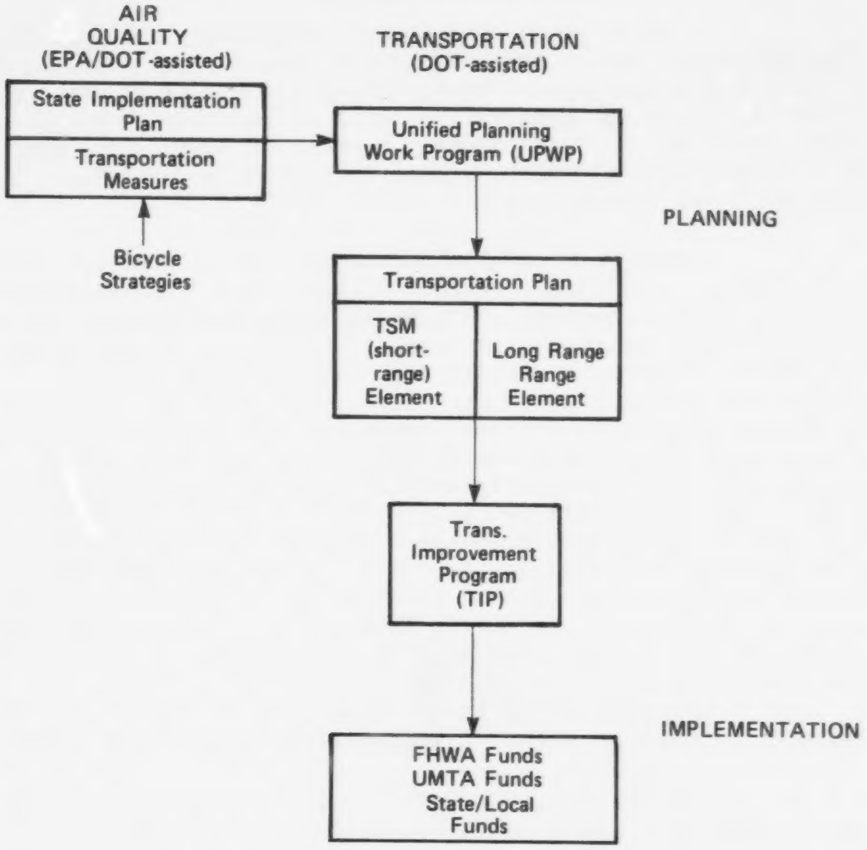
[1] A straightforward explanation of how citizens and organizations can participate in the transportation planning process is available in The End of the Road: A Citizen's Guide to Transportation Problemsolving (Washington, D.C.: National Wildlife Federation and Environmental Action Foundation, Inc.), 1977.

Figure 4-4
COORDINATION OF AIR QUALITY AND TRANSPORTATION PLANNING AND IMPLEMENTATION


AIR QUALITY (EPA/DOT-assisted)
State Implementation Plan
Transportation Measures
Bicycle Strategies
TRANSPORTATION (DOT-assisted)
Unified Planning Work Program (UPWP)
PLANNING
Transportation Plan
TSM (short-range) Element
Long Range Range Element
Trans. Improvement Program (TIP)
IMPLEMENTATION
FHWA Funds
UMTA Funds
State/Local Funds

KEY:

DOT = U.S. Department of Transportation
EPA = U.S. Environmental Protection Agency
TSM = Transportation System Management Element
TIP = Transportation Improvement Program
FHWA = Federal Highway Administration
UMTA = Urban Mass Transportation Administration

Under the new guidelines, bicycle and other transportation measures included in the air quality plans (SIPs) and which require planning are to be included as part of DOT's Unified Planning Work Program (UPWP). The prospectus prepared under the UPWP is to be revised to include all air-quality related transportation planning activities anticipated within the area and is to describe the responsibilities of the respective agencies involved. The DOT and EPA regional offices will have the opportunity for joint review of the UPWP, as well as other planning elements.

Short-range bicycle activities, which can be quickly implemented, such as special sign installation, should be considered under the short-range Transportation System Management Element (TSME) of the transportation plan. The DOT regulations on the TSME specifically mention bicycle programs, stating that "automobiles, public transit, taxis, pedestrians and bicycles should be considered as elements of one single urban transportation system". Bicycle measures are further listed under "Actions to be Considered" (13). Major facilities such as extensive separated bike paths should be considered under the long-range element.

The Transportation Improvement Program (TIP) is a staged multi-year program of transportation improvements consistent with the Long-Range Areawide Transportation Plan and covering a 3-5 year period. Air quality measures including bicycle strategies must be included in the annual element of the TIP to qualify for UMTA or FHWA funds (13).

Boston provides an example of how the process actually works. The 1973 State Implementation Plan contained some bicycle transportation measures, included largely because of strong support by a local bicycle organization. Bicycle parking facilities (racks) were included in the TSME for mass transit stops on the MBTA (Massachusetts Bay Transit Authority) commuter lines. The TIP included this measure, and in January 1976, an application was submitted for UMTA Transit Efficiency Project grant funds. The grant was approved in October 1977 and the racks were delivered in March 1979 (14).

Several types of assistance are available for bicycle programs through DOT. The Department has sponsored or produced a number of bicycle documents, including a recent study on the energy conservation potential of bicycle transportation, mandated by the National Energy Conservation Policy Act. The results of this study are to include a target for bicycle use in commuting and a comprehensive program to meet these goals. The report should be forthcoming shortly.

Bike facilities are eligible items for the use of highway trust funds when they are incidental features of a highway project. Section 217 was added to the Federal-Aid Highway Act of 1973 to allow the use of Federal-aid highway funds for construction bicycle facilities (see Appendix F). Bicycle facilities must compete with other highway programs for use of funds, but substantial total amounts of money ($45 million per year, $2.5 million per state) are available under this program.

A special $6 million bikeway demonstration program was established through the Federal-Aid Amendments of 1974. However, as the House Conference Report on the Surface Transportation Assistance Act of 1976 noted, only a small number of the 495 projects proposed for over $141 million in Federal-State-local costs, were able to be funded. Therefore, the Committee recommended a new bikeway program, stating "The Committee recognizes the continuing interest nationwide in promoting bicycle use and feels there are great benefits to be obtained from an additional Federal investment in bicycle facilities."[1] Twenty million dollars were authorized for each of the fiscal years 1979-82, $10 million to come from the Highway Trust Fund and $10 million from general funds. Funds are to be supplementary to those provided under 23 U.S.C. 217. The Federal share would be 80% of total project cost. This program, incorporated into the 1978 Surface Transportation Assistance Act of 1978 under Section 141(c), was in the process of receiving a $4 million appropriate in the fall of 1979. (See Appendix F for a copy of this and other DOT-bicycle program legislation).

Other DOT assistance programs include the highway safety program administered through the Governor's Highway Safety Representative. This program provides funds, on a federal-state cost sharing basis, for states to develop safety programs, including bicycle safety measures. Many bicycle programs have used these funds, including programs described in Section 5 of this document.

Planning activities can be included as part of the 3 C program, administered through the local UMTA offices and the Metropolitan Planning Organizations (MPOs). Bicycle facilities such as bicycle parking facilities at transit stations can be included under the UMTA Mass Transit Grant program. Bicycle facilities can also be funded through UMTA's Transportation Improvement Program. A summary of the DOT programs is included in Appendix E.

4.3.2 U.S. Environmental Protection Agency (EPA) Programs

EPA's Section 175 Planning Grant Program provides funds for air quality planning, including planning for bicycle strategies[2]. Grants, to be used primarily for development of strategies to reduce ozone and carbon monoxide pollution, are available to organizations of local elected officials. The draft regulations call for administration of the $50 million program through the Urban Mass Transportation Administration (UMTA) of the Department of Transportation, in accordance with the DOT-EPA Interagency Agreement of Movember 3, 1978.

Bicycle projects that can be funded under the section 175 grants include:

- bicycle route and facility mapping
- bicycle use/demand studies
- studies to determine bicycle modal shift potential
- studies to determine air quality benefits from mixed mode travel (bike-bus, bike-transit)
- bicycle education programs to encourage bicycle commuting

More information is available in EPA's Bicycle Programs and Urban Air Quality Grants publication. Examples of bicycle activities already included in Section 175 applications are included in Figure 4-5.

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[1] House Conference Report No. 95-1797, Oct. 14, 1978.

[2] N.D. Rowe, "Bicycling and the Clean Air Act", U.S. Environmental Protection Agency, Washington, D.C., 1979.

Figure 4-5

Bicycle Activities in Section 175 Applications, as of September 1979

Region	State	Urban Area	Bicycle Projects	Amount EPA Funds Requested
I	Mass.	Boston	Evaluate feasibility of implementing bikeways and/or related facilities in municipalities; determine impact of such facilities on air quality (Minute Man Area Bikeway, bicycle facilities in Scituate, Walpole and Wellesley).	$25,000 for staff salaries
	R.I.	Providence	Inventory hazards along possible bike routes in metropolitan area. Produce bicycle maps.	$10,000 for staff
II	N.Y.	Albany	Non-corridor studies (for downtown or other specific area) related to bikeways and elderly and handicapped transportation Efforts to pursue implementation of adopted bikeway element of Regional Transportation Plan includes identifying routes, bicycle safety programs, ensuring adequate bicycle and pedestrian accomodations in highway improvement projects, and determining the effect of increased bicycle usage on air quality.	
		Nassau County	Preliminary route development of county-wide Class I/II Bikeway System	
		Rochester	Metropolitan Area Bikeway Plan to be developed	$3,000
		Capital District	Analysis of bikeways and bicycle storage	

Source: Nina Dougherty Rowe and EPA Regional Bicycle Coordinators, 1979

[1] Many localities did not specifically identify the portion of their 175 grant which would be used for bicycle project planning.

Figure 4-5, continued

Region	State	Urban Area	Bicycle Projects	Amount EPA Funds Requested
III	Pa.	Philadelphia	Identification of specific bike projects	
	Del.	Wilmington	Promotion of bike programs in Newark, New Castle area, facility improvement, bicycle storage, and bike maps in 1980.	
	Md.	Baltimore	Bicycle Locker Demonstration program, FY 1980. Lockers to be installed at six month intervals. Users will be surveyed & bike lockers evaluated.	
	D.C.	D.C.	Identification of specific bike projects.	
IV	Fla.	Pinnellas	Bikeway Study	
V	Ill.	Chicago	Inventory bikeways and storage facilities, development of a plan to implement	$15,000
		Rock Island	Analysis of bike measures along with other measures	
	Ind.	Indianapolis	Analysis of bike measures along with other measures	
		South Bend	Analysis of bike measures along with other measures	
	Ohio	Akron	Update files on bikeways and existing facilities, identify short range transit improvements including bikeways	
		Dayton	Bikeway system plan	
	Michigan	Lansing	Analysis of possible bikeway routes	
	Missouri	East-West Gateway	Determine feasibility of bicycle facilities as an air pollution control strategy	
			Support campaign to promote bicycle commuting	
VI	Texas	Dallas	Analysis of all reasonably available control measures (bikeways and bike storage included)	
		Houston	"	
		San Antonio	"	

Figure 4-5, continued

Region	State	Urban Area	Bicycle Projects	Amount EPA Funds Requested
VI	N. Mex.	Albuquerque	Analysis of all reasonably available control measures (bikeways and bike storage included)	
	Okla.	Oklahoma City	"	
		Tulsa	"	
	Ark.	Little Rock	"	
	La.	New Orleans	"	
		Baton Rouge	"	
		Shreveport	"	
VIII	Colo.	Colorado Springs	Bikeways and storage facilities included in alternative analysis of transportation measures, bike maps	
	Utah	Salt Lake	Alternative analysis including bikeways and storage facilities	
		Provo	"	
X	Calif.	All	Bikeways and bicycle storage will be analyzed along with other reasonably available control measures	

The Federal Water Pollution Control Act amendments of 1977 provide funds for the planning and construction of publicly-owned wastewater treatment and collection facilities (Section 201) and a program for area-wide water quality management (Section 208). Section 201 of the Amendments states that the EPA administrator "shall encourage waste treatment management which combines 'open space' and recreational considerations with such management".

Bicycle facility construction can be combined with water management facilities by using the right-of-way areas for the pathway. Grand Isle is an example of such use. Another example is in California where the State Department of Water Resources has allowed bicyclists access to a twenty mile stretch along the California Aquaduct. This bikeway segment just north of Los Angeles makes use of a surfaced maintenance road that is free of motor vehicle traffic. The bikeway is popular among cyclists who want to escape the congestion of the urbanized coastal communities.

4.3.3 U.S. Department of Housing and Urban Development (HUD) Programs

An interagency agreement between HUD and EPA stipulates that in activities funded through the Comprehensive Planning Assistance Program (701), "grant recipients shall, as a condition of continued eligibility for funding 1) incorporate any land use related measures identified in the SIP as necessary for the attainment and maintenance of the NAAQS as performance criteria, and 2) reflect any State or Federal programs for prevention of significant deterioration of air quality".

In addition, 701 recipients and air quality planning agencies are encouraged to use "common data bases, common analytic techniques, and consistent criteria in their planning activities and to adopt compatible work programs and implementation strategies".

Bicycle coordinators should contact planning staff members early to ensure that bicycle provisions can be included in the relevant portions of the comprehensive plan, including the transportation, parks/recreation, land use, and zoning portions. The data base may be useful during the continuing bicycle program planning and implementation process.

The Community Development Block Grant Program (CBDG) can also be used for projects which include bicycle facilities.

4.3.4 U.S. Department of the Interior (DOI) Programs

The major Interior program related to bicycle use is assistance for state-level recreation facility planning. Many states have surveyed bicycle use and demand under this program. For example, a 1978 telephone survey for the State Comprehensive Outdoor Recreation Plan (SCORP) in Nebraska showed that, for the almost 2000 people contacted, bicycling was by far the most popular outdoor activity out of the 29 activities studied (15).

Because many of the state surveys show bicycling to be a very popular activity, bicycle riding facilities have been built in many recreational areas. Whenever possible, such facilities should support the SIP bicycle strategy goals by linking into a larger network of bikeways serving the area.

An example of a multipurpose bikeway is one developed by the New York State Department of Parks and Recreation in Grand Isle. The route connects two state parks with schools and the Grand Isle Civic Center. The right of way for this recreational corridor was made available through an EPA policy for Section 201 assistance under the Clean Water Act of 1972. This policy encourages multiple use of waste water interceptor alighments. The project, the cost of which was shared by the State Parks Department and the U.S. Heritage Conservation and Recreation Service, brings together many outdoor activities through creation of the bikeway link.

4.3.5 State Programs and Funding Sources

Funding resources for bicycle projects and programs at the state level most often consist of the state's matching share of federal programs or in-kind services. However, some states have special programs: Massachusetts currently is using a special $3 million bond issue for bicycle facility construction assistance to localities.

Specific state agencies which may contribute funds or services include the Departments of Transportation, Highways, Public Works, Planning, Community Affairs, Education, Law Enforcement, Parks and Outdoor Recreation, Energy Conservation, and Air Quality.

The Department of Highways (or Transportation) is the most frequently used state source of bicycle project construction funds. The application and funding procedures parallel those that would be followed for a street or highway project seeking state and federal assistance. For example, the Oregon State Highway Department appropriates 1% of its annual budget for pedestrian and bicycle facilities. This money is from the Highway Users' Fund, exclusive of any federal involvement. Localities in Oregon must also appropriate bicycle matching funds to receive state aid. The State of Washington has a similar program.

State energy offices generally examine methods for conserving gasoline through transportation measures. They prepare emergency plans as well as longer range strategies. Examples of how energy offices can support bicycle programs include the Oregon Department of Energy-assisted bicycle commuter service Hot Line in Portland, and the Washington Energy Extension Service (WEES) which is offering talks and slide shows in King County on use of bicycles for commuting and recreation.

4.3.6 Regional Programs and Funding Sources

Although regional sources are limited, the DOT-designated metropolitan planning organization (MPO) can assist in bicycle facilities funding through inclusion of local bicycle facilities in the Transportation Improvement Program (TIP) and later through distribution of "Urban Systems" funds.

Special-purpose regional service districts are a potential source of in-kind services. Transportation districts are one example. Shared rights-of-way, bike-and-ride programs, and secure parking facilities may be provided by such districts. For example, the Bay Area Transit (BART) District provides bicycle storage lockers at its rail stations and permits bicycles to be carried on the transit cars during off-peak hours.

Watershed management, sewage, and flood control districts are other examples of special-purpose regional districts which may include bikeways in conjunction with their other construction activities. Most of the regional agencies are both federally and locally funded. A bicycle coordinator can help to insure that all these sources are investigated and utilized when appropriate.

4.3.7 Local Public Programs and Funding Sources

Many bicycle programs and facilities are funded at the local level, either through complete local funding or through a matching share of a regional, state, or federal program. A major advantage of local funding is the short turnaround time between requests and funding--generally within a year. Possible sources of direct financial or in-kind assistance are summarized in this section.

Research and planning funds and staff time may be available from the local planning department. Other departments, such as parks and recreation, public works, police, and local school departments, may provide similar funds or services. Services provided by these departments may include construction of paths within parks, signing of routes, provision of police staff for education and enforcement programs, inclusion of bicycle education in class instruction, and inclusion of special bicycle provisions in the zoning ordinance.

The bicycle program in the town of Lincoln, Massachusetts, is an example of a bicycle program which was completely funded locally. Funds for over five miles of separated bike paths were approved by Town Meetings. Labor was available at no charge to the bicycle program through use of the Public Works crew during "down time". Services have been made available through the local Police Department for a bicycle safety clinic conducted by one of their officers and a local bicycle shop owner.

Sources of direct funding may include the local capital improvement budget and bond issues. For bikeway construction, the capital improvement budget is a primary resource. Major construction of bicycle facilities sometimes requires a bond issue referendum. Bonding brings the cost of a facility down on a year-by-year basis and, although increasing the total amount paid, it may make a construction program more attractive to taxpayers.

4.3.8 Private Programs, Organizations, and Funding Sources

Many communities contain private organizations that might be interested in participating in bicycle-related projects or programs. These organizations are more likely to make in-kind, rather than direct, financial contributions.

Donations of private land or easements can contribute significantly to the development of a bicycle system. Private land owners may contribute acreage to parks, open space, or recreational corridors where a bikeway facility is to be established. Some localities, such as Lincoln, Massachusetts, have used easement contributions for a large portion of the bikeway system. A legal agreement (easement) can be drafted allowing public bicycle access with public liability but retaining private ownership.

Universities and private developers may voluntarily set aside corridors for bicycle travel. The University of California at Santa Barbara is an example of such corridor and facility provision.

Private developers may also provide land and/or bicycle facilities. Planned new areas such as Peachtree City, Georgia, and Reston, Virginia, are examples where developers provided bike paths.

Other easement or "right-of-way" opportunities exist over abandoned rail lines, old towpaths and canals, utility rights of way, highway rights or way, and other easements. An example of a bicycle path utilizing such an easement is the Illinois Prairie Path, a 35 miles path just west of Chicago on an abandoned railroad line. The Commonwealth Edison Company shares the easement and helped to clear the way for the trail. The success of this path spurred the utility company to set aside over 1,000 miles of its own right of way for recreational and other secondary uses.

Interested individuals have often been instrumental in implementation of such paths. Mrs. Abigail Watts organized the effort for the Illinois Prairie Path, while Justice William O. Douglas did so for the C & O Canal in Washington, D.C., which is accessible to several million people and runs 184.5 miles. Similarly, the 67 miles of path along the California Aqueduct running north to south in California, was the result of three years of effort spearheaded by Mrs. Artermis Ginzton, a bicyclist. Further information on use of rights of way for bikepath implementation is contained in From Rails to Trails, a publication of the Citzen's Advisory Committee on Environmental Quality, and in Availability and Use of Abandoned Railroad Rights of Way, a report by the U.S. Department of Transportation to the President and Congress in response to Section 809(a) of the Railroad Revitalization and Regulatory Reform Act of 1976.

Members of bicycle organizations can provide valuable assistance during the SIP planning and implementation process, including political support and first-hand knowledge of bicycle incentives and deterrents. The Boston Area Bicycle Coalition (BABC) is an example of such a group, whose members were instrumental in urging inclusion of a bicycle strategy in the original Boston SIP process.

More recently, the Bicycle Commuters of New York (BCNY) have participated vigorously in preparation of the New York SIP. Their activities include submission of bicycle oriented strategies and pilot projects to the Citizens Advisory Committee and oversight committee. BCNY members also testified at hearings. As a result, the 1979 SIP includes one of the half dozen pilot projects proposed by BCNY members. The pilot project will create a 24-hour bike lane on the Queensboro bridge (17).

Similarly, League of American Wheelmen members assisted in development of the 1979 Southeastern Pennsylvania SIP. Their activities included comments and testimony on the SIP, and a request for voting representatives from the bicycle community on both the technical advisory committee on transportation and the policy committee for air quality (16).

4.3.9 Combined Use of Programs and Funds

Examples of the successful use of different types of programs and funding sources--federal, state, and local--are contained in the case studies in Section 5. A good example of combined use of funds is the Sacramento Northern Railroad Bikeway project in California. This 10.4 mile commuter bikeway uses Sacramento City funds, County funds, and state funds. The City of Concord, California, is also using local and federal funds for construction of a 3 mile separated bikeway for commuters along an old railroad right of way connecting the town and a transit station. The Federal Bikeway Demonstration Program (FHWA) was used for the federal share.

Another good example of combined use of funds is contained on page 203 of Appendix E. The Platte River Greenway Foundation combined funds from private, local, state and Federal sources to construct a ten mile bicycle path and other recreation facilities along the Platte River in Denver. Private funds included individual contributions, corporate donations, and foundation funds. The Mayor's Revenue Sharing Fund provided part of the local share, along with a city council match appropriation and capital improvement funds. State funds came from the Conservation Trust Fund, the Urban Drainage and Flood Control District, general revenue funds, Centennial-Bicentennial Commission contributions, and State Trails Committee funds. Finally, Federal contributions included Highway Urban Systems funds, EDA Local Public Works Employment Act money, and assistance from the Land and Water Conservation Fund as well as HUD's Community Development Fund.

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SECTION 5: CASE STUDIES

5.0 Introduction -

This section contains descriptions of five bicycle programs: Davis (California), Madison (Wisconsin), Denver (Colorado) and the states of North Carolina and California. These programs provide concrete examples of major points made throughout this information document.

Common features of these five programs include:

- a solid record of concrete accomplishments
- highly motivated program administrators, some of whom initiated the programs
- strong enabling legislation
- clear assignment of responsibility for bicycle transportation given to program administrators by public agency
- location of all or a part of the bicycle program in the transportation or public works agency
- support by transportation agency administrators for the bicycle program
- adequate levels of funding
- prestigious position for bicycle program administrator (i.e., title, civil service level)
- political support
- cooperation with other interested agencies
- use of a variety of funding sources

In addition to common features, the case studies illustrate how the initial motivating force for bicycle programs may differ. For example, citizen perception of the need for bicycle programs and pressure through the political system characterized the beginning of the Davis program. The Denver example illustrates how pressure by bicycle organizations can also be effective in program initiation. The North Carolina example illustrates how a highly motivated individual can be instrumental in initiating a program. The Madison and California examples illustrate this point as well. While programs may begin differently, one of the program administrators noted that public, political, and administrative support must all be present for a strong program to continue. Such support can, of course, be encouraged by program administrators and advisory committees appointed at the inception of a program.

The case studies in this section describe some of the most active bicycle programs in the U.S. Local organizations and individuals without bicycle program experience, who are interested in improving air quality, can learn from these experiences. We encourage you to contact the administrators of these programs directly for more specific information and advice.

5.1 Davis, California

With 28,000 bicycles owned by a population of 35,000 (1), Davis is an outstanding example of how a small city can encourage bicycle transportation. Although a warm climate, dry (although hot) summers, flat terrain, a large number of students at the University of California, generally informal dress, many existing wide streets, an and a large percentage of residents living within 2 miles of the university and downtown contribute to a favorable environment for bicycle riding. However, adjacent towns with somewhat similar conditions, but without bicycle programs, do not have a high rate of bicycle use. Davis residents ensure that bicycling remains a transportation alternative through strong political support.

In the early 1960s, as the campus expanded, the population increased, streets became busier, and space for bicycles on the road decreased. Local bike shops reported an increase in damaged front wheels as bikes were squeezed onto the curb by passing cars. A group of concerned citizens looked for a way to separate bicycles from the growing numbers of cars. Initially, a proposal for bicycle paths was turned down by the City Council as impractical and possibly dangerous. Proponents were considered cranks (2).

However, widespread support for bicycle facilities became apparent as discussions continued. A petition to the City Council was signed by 90% of the several hundred voters whose signatures were requested. A major issue in the 1966 city election was bike paths, and the pro-bikeway candidates won. As a result of strong political support, a bicycle program was set up to plan and implement a system of bikeways. Since that time, over 14 miles of bike lanes, 7 miles of bike paths, and street and rail grade separations have been constructed in Davis (3).

Parking facilities have also been installed in a number of locations. For instance, bike racks have been added to most downtown areas.

Initial and some subsequent funding of onstreet bike lanes was provided through gasoline tax revenues (4). City funds have been used in some cases, and bikeways have been built by developers. If shown as part of the bike path system contained in the Master Plan, developers may be required to provide bikeways and a dedicated right-of-way. Adequate street width for bikelanes is also required, and bike connections with public facilities and shopping may be requested. Downtown parking facilities have been donated, in some cases, by public service groups.

assistance from city officials. A change in bikeway signing illustrates the kind of practical improvement made on the basis of evaluation. Some confusion was noted among automobile drivers, particularly those from out of town, as to the meaning of "bike lane" or "bikeway" signs. Occasionally a driver would be found using the bike-lane, apparently interpreting the signs to mean bikes must use the area, but cars can also. Therefore use of the phrase "bikes only" was recommended and implemented.

In addition to physical facilities and evaluation, the bicycle program includes education and enforcement programs. Six separate programs are administered through the police department. The school-related programs include a planned curriculum for children from kindergarten through ninth grade, a bike rodeo, a bicycle safety check day, and a bike safety training school including both training on school grounds and on the roads.

The registration program has recently been transferred to the university because of Proposition 13-related staff and budget cutbacks in the Davis Police Department (5). Licenses cover a three-year period. An estimated 1% of college student bicycles are stolen each month (6). Therefore, entry of license data in the State Department of Motor Vehicle computer system is an attractive feature of the program since return of stolen bicycles is facilitated.

Enforcement of bicycle and motor vehicle laws and regulations relating to bicycle safety is handled by regular patrolmen in addition to a Bike Enforcement Officer. A ten-speed bicycle is often used by the Bike Officer when on duty. The city's Bicycle Regulation (7) permits the following penalties to be imposed for violations by those under 18 years of age:

a) attend traffic school for a period of six Saturdays

b) be deprived of bicycle for a period not to exceed thirty days

c) have parents of violator deprive violator of bicycle for a period not to exceed thirty days

d) write a composition of not less than 200 words on a subject title specified by the chief of police or his representative

e) obtain a city bicycle license immediately and pay the penalty

f) copy the section of bicycle chapter violated 100 times.

Applicable provisions of the traffic laws for drivers of vehicles apply to adults. Strict enforcement of the parking regulations has contributed to the bicycle program by keeping bike lanes free (6).

How important are these programs in increasing bicycle use? A study by DeLeuw Cather reported that over 25% of all travel in Davis is by bicycle (4). In a door-to-door survey in a middle-class single-family neighborhood in Davis, 60% of the adults aged 25-35 owned bikes, 46% of those 36-45 did, as did 14% of those over 46 (8).

A survey of a class at each grade level indicated that no kindergarten children had ridden bikes to school, compared with 22% of first-graders, about 50% in grades 2-5, and 71% of sixth-graders (8). When parents were asked about their children's bicycle use, most believed it was safe for children to ride bicycles in Davis, largely due to bicycle lanes. Almost everyone wanted more lanes and more law enforcement.

Almost half of the junior high school students (80% of those not using the bus) rode bicycles to school every day (8). Use of bicycles for other purposes, such as trips to movies, was common. Sixty percent of the high school students not going by bus rode their bikes to school (8).

Among college students, 89% of the freshman and sophomores, 79% of the juniors and seniors, and 61% of the graduate students kept bicycles at their campus residences (2). Distance is an important factor in use, with 70% of students living 1-2 miles away from campus using a bicycle. Students living within a mile averaged about 10 round-trips a week; those 1-2 miles away averaged about 5 round trips a week (2). The majority of those living more than 3 miles away, however, used a car.

A survey indicated non-student young adults also used bikes at high rates. About 70% used bicycles, although for fewer round trips than students (8).

Because it is difficult to disentangle the effects of generally favorable conditions, such as climate, from bicycle program effects, "control" communities with similar conditions but without bicycle programs were examined. A survey was undertaken in Woodland, a city of about the same population size located near Davis. With the same climate and topography, but without Davis' bicycle program, bicycles were viewed as incidental. Respondents lacked contact with bikeways and had no opinion about them (2). While Woodland children did ride bicycles to school, only 7% of the high school students not bussed rode bicycles compared with 60% in Davis. For junior high school students, the comparable figures were 38% in Woodland compared with 80% in Davis (4).

Two University of California psychologists, Robert Sommer and Dale Lott, have evaluated the bicycle programs over a period of years. They have examined similar areas with warm climates, similar terrain, and universities but with much lower levels of bicycle use such as Stockton, with the University of the Pacific; Santa Barbara, with its University of California campus; and Sacramento, with its State College. Based in part on these comparisons, they have concluded that bicycle programs are important factors in increasing the use of bicycles. In their words:

> Just as the automobile requires the availability of gas stations, good roads, highway regulation, licensing procedures and driver education, so the bicycle requires, in addition to moderate climate and terrain, the separation of bicycle from automobile traffic at some points, the respect of motorists at intersections, special regulations pertaining to bicycles, bicycle racks in sufficient numbers in the downtown areas and bicycle education in the schools (2).

Detailed analysis of the effects of the bicycle program on air quality and energy savings has not taken place. However, it has been estimated that use of bicycles saves an automobile trip per day for every two households in the city. This is equivalent to about 7,000 trips per day which would otherwise be taken by car. Since Davis is located in a valley where air inversions occur--particularly in the fall when agricultural burning of rice fields takes place--bicycle use obviously reduced air pollution.

The bicycle program is also part of a city-wide energy program. Based on a questionnaire distributed to residents in the early '70s, a general plan was developed. The goals of the plan were to limit growth and to conserve land, water, energy, and other natural resources. Since the survey indicated that automobiles accounted for 50% of personal energy use in Davis, the bicycle program, along with land use limits and encouragement of work at home, became an important focus of the energy program (10).

For more information, contact:

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Public Works Director
City of Davis
226 F St.
Davis, California 95616
(916) 756-3740, ext. 14

5.2 Madison, Wisconsin Area

Madison, Wisconsin is a good illustration of a comprehensive bicycle program underway in a non-attainment area. The program includes the four "E"s--engineering, education, enforcement and encouragement. Furthermore, the program is supported by, and integrated with, both regional and state-level bicycle programs.

As in many localities, the original bicycle Master Plan had been "prepared through purely subjective means without the benefit of user surveys, etc." (1). Clear goals, objectives, policies, and standards were lacking when the 1971 bicycle facility plan was prepared (1).

Adult bicycle use increased in the early '70s and Madison evaluated needs, bicycle demand, and accidents. Three major surveys were made in 1974. These included a mail-back survey, interviews of over 1800 bikers, and a survey of bicycle users in all public and parochial schools in the Madison area.

The surveys provided encouraging data on existing and potential bicycle use. For example, 68% (144,000 of the total area population of 212,000) considered themselves bicycle users. About 50,000 bicycle round trips per day were made in Madison. About 4% of all vehicles were bicycles during a 37 location vehicle count.

Although respondents noted that cold weather, snow, and rain inhibited bicycle use, seasonal field counts indicated some bicycling takes place year round. Of the weekday trips, almost 30% were for work, 40% for school, and 7% for shopping. Recreational trips accounted for about 20% of the total. The survey also indicated that parking facilities are essential for bicycle security. Eighty-three percent thought more money should be spent on safe bicycle facilities. Twenty-one percent of adult non-bikers said they would bike to work, and 49% said they would use a bicycle for recreational purposes if better facilities were provided (2).

As a result of this survey, seven local units of government, including the cities of Madison, Middleton, and Monona, the Villages of Maple Bluff, McFarland, and Shorewood Hills, and Dane county participated in a joint planning effort. Twenty miles of bikeway were proposed in a short-range plan for an estimated construction cost of $86,270 and maintenance expenses of $7,390. The long-range plan included about 16 miles of bikeways and an expensive overpass for a total estimated construction cost of $691,709 and about $40,000 for maintenance.

In addition, the hiring of a coordinator was recommended, to be funded through the CETA program initially. Many other recommendations were made including a registration program and ongoing monitoring.

A coordinator was hired and was so successful that the city is currently developing a request for a full-time position. Most of the short-range plan was implemented. Two police officers were assigned to ride bicycles and enforce the bicycle safety provisions. The state education program was used in the Madison schools, and many of the other recommendations were implemented. In addition, the county has provided 54.3 miles of wide shoulders for bicyclists (3).

Another major survey effort is currently being planned which should provide comparative data on the effects of the bicycle program (4).

For more information, contact:

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City/County Building
210 Monona Ave.
Madison, Wisconsin 53709
(608) 266-4761

5.3 Denver, Colorado

Since the first bicycle plan in 1972, Denver has undergone two full cycles of bicycle planning and implementation. Initial problem identification occurred in 1971 when a local bicycle activist organization, Bicycles Now, staged a series of police-escorted bicycle support rallies. The focus of the demonstrations was the Denver City Hall, and the demonstrations attracted up to 4,000 people. City Council responded by passing a resolution requesting the planning office to study and make recommendations for a bikeway system.

The Denver Bikeway Plan was completed in 1972. It was a carefully researched and well received plan which focused on route development and intermodal (bus) connections. In 1973, six miles of lanes were implemented for commuter use, and a pilot bikeway connecting several parks in a north-south route was established. During 1974 and 1975, the Denver City Council appropriated $100,000 each year and created 33 miles of bikeways. This constituted 20% of the original 164 mile system plan (1).

By 1976, the activist groups had dissolved, the city planner had moved to a new job, and the city was left without a professional to follow through on the system development as both advocate and evaluator. In 1976 and 1977, economic conditions left no capital improvement funds available for bikeway construction.

A statewide conference, Bicycling in Colorado, was held in 1977 to evaluate the existing status of bicycling from a statewide perspective. The conference was organized to identify problems and propose solutions to questions of facility design and funding, program coordination and legislative needs. The conference report concluded that current facilities were discontinuous, planning too often emphasized costly paths when on-street facilities were available, and facility plans lacked provisions for maintenance (2).

An example of the lack of coordination which was raised at the conference was the development of a 10-mile linear park through the city which included a well constructed 8-foot-wide grade-separated bike path. The Platte River Greenway project required $1.4 million to construct. It had two significant characteristics in relation to the community's existing bikeway system: the Greenway was designed with little connection to the city's existing system, and it was difficult to get to with only two or three access points along the entire ten-mile distrnce. As a consequence, the Greenway was little used by bicyclists for either commuting or recreation.

Based on workshop reports which evolved from the Bicycling in Colorado conference, Mt. Bicyclists' Association determined that a regional access map which connected usable streets and existing bikeways into a system should receive top priority. There were no maps available at the time to show cyclists where to ride and how to access major regional destinations. Additionally, the map would assist in determining what facility development was required to make the city and the region more accessible to bicycle traffic. The map sbusequently detailed over 500 miles of usable routes, including the first appearance of the Platte Greenway on a map. The region's street system was adequate, in most cases, to connect the discontinuous official routes into a system.

The conference and the new regional map had the effect of stimulating renewed evaluation of bicycle transportation among local cyclists and public agencies. By 1978, the region's severe air pollution problem dominated public debate. Preparation of the State Implementation Plan (SIP) focused public attention on defining alternatives to the heavy automobile reliance of area residents. Bicycling was frequently advised as an important alternative in public hearings on the content of the SIP. Support came from business, government and many citizens. In response to a provision of the SIP, the Denver Regional Council of Governments has formed a Bicycle Advisory Committee and is preparing the first Regional Bikeway Plan.

A major problem in the Denver region, as noted earlier, has been the lack of coordination of bicycle facilities on the basis of a regional plan or strategy for bikeway development. The Regional Bikeway Plan, currently being prepared, is the first step in that direction. The Regional Bikeway Plan, when adopted by the Denver Regional Council of Governments, will be used as the basis for allocation of federally funded bikeway projects.

The Regional Bikeway plan will be focused primarily on commuter bicycle transportation, i.e. utilitarian trips. Currently nearing completion, the plan identifies routes to designated activity centers (destinations of cyclists for work, shopping, and personal business activities) from surrounding 2 and 4 mile travel sheds. Linkages between activity centers are also provided where activity centers overlap and where activity center interaction has high potential.

The plan also is cognizant of the need for bicycle storage facilities and suggests financial incentives for the private sector to provide bicycle storage facilities at trip attractors.

Within Denver's city limits, the Mayor appointed a Policy Advisory Committee on Bicycle Commuting. This committee works with a new bicycling program coordinator in the Denver Planning Office. In 1979, the Advisory Committee elected to emphasize bicycle parking through a study and plan. The parking plan will complement the Revised Denver Bikeway Plan as a major incentive to increased bicycle use.

The Revised Plan, the second generation effort, will emphasize on-street routes, shifting away from the lane and path approach taken in the original bikeway plan in 1972. Capital improvements are focused on barrier removal projects rather than linear paths.

The '79 Bikeway Plan proposed 84 miles of additional on-street routes, no new lanes, and 21 miles of bikepaths. No lanes were proposed because streets with adequate width were identified. This will minimize construction costs and annual maintenance expense as well. The total existing and proposed 210 mile network is composed of 3% lanes, 32% paths, and 65% Class III routes (3).

Despite substantial planning and implementation efforts, a corresponding reduction in accidents is not occurring, nor is utilization increasing substantially (4). A recent study (5) supports the argument that while facilities are required for barrier removal and route continuity, it is the cyclists' fear of accidents which continues to act as the greatest identified barrier to bicycle use.

In July, 1979, the City of Denver and the State Office of Energy Conservation Coordinated the first Annual Denver Bike Expo to encourage commuter and recreational bicycling. The Expo was held in a popular downtown plaza where demonstrations, exhibits and information was made available to the public. Incredibly, 26 agencies and private groups participated directly in this promotion of bicycling. The Denver Bike Expo was a success and plans are being made for an expanded 1980 program.

For more information, contact:

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Mr. George Scheuernstuhl
Director, Transportation Services
Denver Regional Council of Governments
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(303) 455-1000

Mr. Bill Litchfield
State Highway Bicycle Coordinator
Division of Transportation Planning
Colorado Dept. of Highways
4201 E. Arkansas Ave.
Denver, Colorado 80222
(303) 757-9506

5.4 State of North Carolina

In 1974, the North Carolina legislature passed a "Bicycle and Bikeway Act" which directed the North Carolina Department of Transportation to:

- assist local governments with bikeway development
- develop and publish policies and standards relevant to bicycling and bicycle facilities
- sponsor bikeway demonstration projects
- develop and implement a statewide bikeway system

Funds were provided for staff salaries, travel, and for the Bicycle Advisory Committee (1). Federal grants supplement the state allocation of funds.

The bicycle program was created as a result of a paper written by the current director, Curtis Yates, while he was still working for the planning department. His paper, entitled "Bikeways for North Carolina--Bicycle Program Requisites" influenced the North Carolina Department of Transportation to offer him a position as Bicycle Coordinator (2).

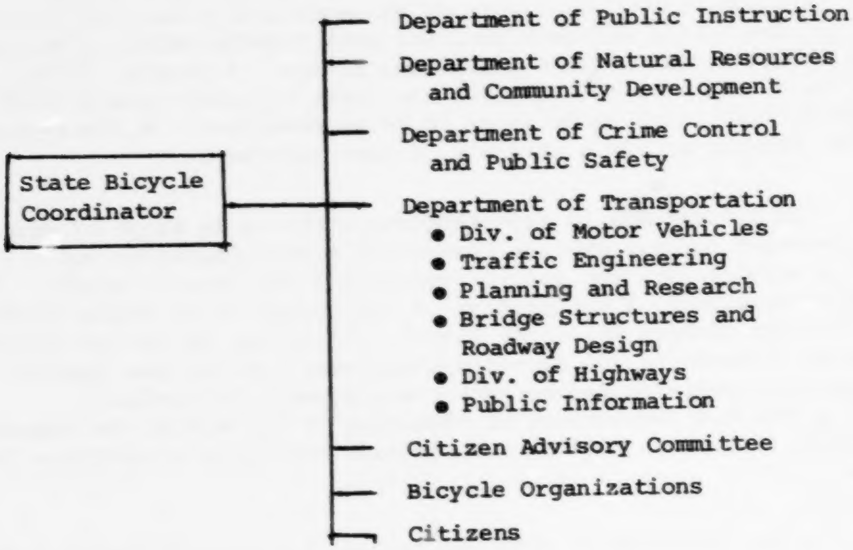
Citizen input was obtained by appointing a seven-member Advisory Committee. Citizen information is partly handled through a newsletter. Interagency coordination is illustrated in Figure 5-1.

North Carolina has been especially successful in attracting federal assistance in the form of Section 402 highway safety funds. A total of $400,000 for bicycle funding was raised through this program to establish a staff position for technical assistance to localities . This money was also applied toward workshops on bicycle facilities and safety held throughout the state. Media spots, bicyclist education courses, and handbooks are other products that resulted from North Carolina's 402 funding.

Over ten projects were completed by 1977 (3-14). These included a review of North Carolina statutes pertaining to the bicycle, a study of the problems and needs of storage facilities for bicycles, a "how to" manual for development of bicycle programs by local areas, and several surveys to ascertain the characteristics of bicyclists in North Carolina.

Figure 5-1

NORTH CAROLINA COORDINATION


State Bicycle Coordinator
Department of Public Instruction
Department of Natural Resources and Community Development
Department of Crime Control and Public Safety
Department of Transportation
● Div. of Motor Vehicles
● Traffic Engineering
● Planning and Research
● Bridge Structures and Roadway Design
● Div. of Highways
● Public Information
Citizen Advisory Committee
Bicycle Organizations
Citizens

Source of Data: M. Meletiou, N.C. Bicycle Program, 1979.

One of the most tangible benefits for North Carolina bicyclists was the development of statewide bicycle systems called Bicycle Highways. Over sixteen maps were prepared, identifying safe highways for bicycling, and providing detailed information on food, lodging, and other services.

About sixteen other projects are currently underway or completed (16, 17). These include a Bicycle Safety Pilot Cities program to demonstrate the effects of a comprehensive bicycle safety program in Greenville and Davidson. Low cost bicycle safety programs will be demonstrated in seven additional cities. A bicycle safety display booth to be used throughout the state in public places such as shopping center and conferences is being developed. A three-year statewide bicycle accident analysis is also underway.

North Carolina is experimenting with a wide range of educational programs. These include elementary school education and bicycle education for both special groups and the general public. A disappointing aspect of the program is the low priority rating given a Kindergarten through 9th grade bicycle/pedestrian safety education curriculum. Tested in 100 school systems over a three year period, this Federally-assisted demonstration was given a low-priority ranking by the N.C. Department of Education at the end of the demonstration period, and state funding was not made available to continue the program.

Other educational programs include a series of summer Pedal Power Camps where safety training will be given to about 300 children, development of a bike rodeo manual, and the addition of a bicycle supplement to the Driver's education Instructor's Manual. An adult education course guide will be made available for use at community colleges and universities in the state. A bicycle information service is underway, which will provide public access to a library, films, bicycle files on specific subjects and informational road shows. A bicycle safety mass media educational program will utilize radio and TV to reach a large audience (18).

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(919) 733-2804

5.5 State of California

California's bicycle program is administered by the Office of Bicycle Facilities, located in California's Department of Transportation (Caltrans). Authorized by the Legislature in 1973, the bicycle program has had strong support by politicians and Caltrans officials (1). As the Secretary of Caltrans wrote in a letter to the state Senate in 1979, "A comparison of California's 16 million registered motor vehicles to the estimated 10 million bicycles owned in California shows a significant potential for the use of the bicycle as an effective substitute to the automobile for utilitarian trips, such as commute trips" (2).

Under Dick Roger's direction, and with a staff of 5 people, the Office of Bicycle Facilities has developed a strong program to provide better physical facilities in California. The program uses Federal, state and local funds for construction and technical assistance within the state.

Federally-assisted projects include use of about 10% of California's Title 23, Section 217 (a) federal aid funds for bicycle projects. Located in the Mendocino, Kern, Los Angeles, Riverside and Stockton areas, in 1978 these projects include construction of 6.2 miles of paved shoulders, 3 miles of bicycle paths and 0.3 miles of bicycle path and bridge. Particularly noteworthy is the substantial amount of funds obligated for bicycle projects ($225,700 out of $2.5 million for the state) when the bicycle projects must compete directly with other federal-aid highway projects for funding.

California also received $297,060 (5%) of the $6 million Federal Bikeway Demonstration Program funds for three projects. The Oakland-San Francisco Bay Bridge Shuttle Demonstration is being implemented by Caltrans. Four vans and bicycle trailers plus operating costs were financed by the $140,000 budget. Begun in September 1977, the demonstration will be continued at least until 1980. Other projects include construction of a bicycle trail in Concord, and a bus/bike project in the City of Santa Cruz.

The authorizing legislation (3) for the Office of Bicycle Facilities calls for an amount of not less than $360,000 of each annual Caltrans budget to be set aside for the construction of nonmotorized transportation facilities in conjunction with the State Highway System. During the fiscal year 1977/1978 approximately $1.3 million was obligated for nonmotorized transportation facilities (4), and in fiscal year 1978/79, $1.46 million was budgeted (5). Facility construction scheduled for FY 78/79 includes about 44 miles of paved shoulders, lane signing and striping at Napa, 2.4 miles of bike lanes, and over 4 miles of path construction. Projects already completed or in construction include about 74 miles of paved shoulder and 4.3 miles of bicycle path.

An appropriation of $30,000 per month is available through the state's Bicycle Lane Account and is administered by the Office of Bicycle Facilities. Priorities for use of the funds are set forth in Section 2383 of the Streets and Highways Code and include:

- construction of Class I bikeways to complete existing routes serving commuters
- construction of other Class I bikeways contained in the city or county bikeway plan
- elimination of hazards to bicyclists on existing bikeways or bicycle routes
- provision of secure bicycle parking facilities serving civic or public buildings, transit terminals, business districts, shopping centers and schools
- other projects implementing the city or county bikeways plan

Funds have been approved for six bikepath projects, totaling almost 10 miles in San Diego, Orange, Sacramento and Los Angeles Counties, the city of Duarte, and the City of Los Angeles.

Senate Bill 283, passed in 1975, provides for the allocation of $4.9 million dollars between 1976 to 1979 for the construction of a commuter bikeway in each county group, and for improvements on the Bikecentennial Route. In 1977, $2.25 million was approved by the Caltrans Secretary for two commuter bikeway projects. The Sacramento Northern Railroad Bikeway is a joint City/County/State project. A 10.4 mile Class I bikeway will be constructed on an abandoned railroad right-of-way, and joins the American River Bike Trail which provides recreational riding and access to California State University. An exclusive bike crossing will be constructed over the America River, and the City of Sacramento will pay for and provide on-street improvements to link the bikeway to downtown employment centers. In addition to these contributions by the city, the County will contribute $134,000, and $1.4 million will be provided by the state.

The San Diego Route Bikeway will receive $850,000 from the state for construction of about 25 miles of Class I, II and III bikeways around San Diego Bay. The bikeway will link with the San Diego-

Coronado Bay Bridge bus-on-bike service, and will serve industrial, military and commercial employment centers along the Bay as well as recreational demand. Six local agencies and Caltrans are participating in the project. The City of San Diego is the lead agency and Caltrans is responsible for project development.

The Bikecentennial Route Improvement Program will receive a total of about $2.6 million when the current projects are completed. Between 1976 and 1978, 31 miles of paved shoulders were provided in five projects, and the City of San Diego received funds for development of bike lanes on a bridge replacement project. Additional projects scheduled for completion include construction of 45 miles of paved shoulders on State highways, and several joint state/local agency funded projects. These joint projects will result in the construction of 28 miles of bike lanes and 3 miles of bike paths.

The Office of Bicycle Facilities has also undertaken three major studies. In 1972 a Statewide Bicycle Committee was formed to make recommendations to the California Legislature concerning bicycling issues of significant importance. This study resulted in legislation revising the vehicle code to realistically address cyclist/motorist rules of the road. Emphasis was on preserving cyclists rights to use all streets and highways while also having the same basic responsibilities as those of motor vehicle drivers.

In April 1977, a Statewide Bicycle Facilities Committee was formed to develop statewide criteria and standards for bicycle facilities. Participants included state and local agencies, bicycling groups and other interested individuals and groups. After public hearings, new criteria developed by the Committee were adopted by the Department in August 1976. The published standards, Planning and Design Criteria for Bikeways in California (6), have received national recognition. Over 3,000 copies have already been distributed, and the Federal Highway Administration has requested permission for national distribution through the U.S. Department of Transportation.

California has led the way for use of freeway shoulders where safer than alternative routes. Caltrans completed a Freeway Shoulder Study in 1977 which resulted in the opening of approximately 230 miles of shoulder in 1978. This increased the total mileage open for bicyclists' use to about 960 statewide. No unusual safety problems have been noted on the freeway shoulders open to bicyclists (7).

For more information, contact:

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APPENDIX A

SUPPORTING FIGURES, SECTION I

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Figure A-1

Bicycle Measures in SIPs, September 1979

Region	State	Urban Area	Bicycle Measure
I	Mass.	Boston	60 bike racks in 11 MBTA stations.
			Mass. Dept. of Public Works (MDPW) bikeway program, bike paths, lanes and routes, signing, publicizing bike routes.
			Education of drivers and bicyclists to rules of the road and bicycling techniques.
			Removal of impediments (e.g. replace drainage grating, enacting parking bans, improving street surfaces, etc.).
I	Mass.	Springfield	Bicycle/pedestrian circulation system on Springfield Riverfront Park
			Bicycle path, Northampton
			Outer belt bike path
			Westfield community-wide complex of bike routes
			Bikeway system on dikes in Chicopee
II	N.Y.	Capital District & Catskill	Bicycle storage facilities, bicycle lanes, areawide bicycle routes
		Utica/Rome	Bikeway and bicycle storage facilities
		Syracuse	Bikeways
		Rochester	Bikeways
		N.Y.C. metro area	Various bikeways (100 mi.)
			Pilot project of 4 commuter routes with Class I, Class II and Class III variations

Source: Nina Dougherty Rowe and EPA Regional Bicycle Coordinators, 1979

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Region	State	Urban Area	Bicycle Measure
II	N.Y.	Westchester County	Route 117 bikeway
			Putnam Bikeway Phase I
			Bronx River Bikeway Phase III
		Nassau County	Bicycle lanes, bicycle storage facilities
			Investigate the implemention of a county-wide bicycle plan
		Suffolk County	Recommendation in SCDOT's Transportation Plan to make provisions for biking facilities when major road construction takes place.
	N.J.		Bike lanes and storage facilities
		Atlantic City	Ventnor City Bikeway, 4.0 miles
			Sommers Point Bikeway, 0.82 miles
			Linwood Bikeway, 1.66 miles
			Hammonton Bikeway
		Phillipsburg	Phillipsburg, 2 bikeways consolidated, 1.5 miles
			Hopatcong - Belvidere Rd. Bikeway, 0.5 miles
		Bergen	River Edge-Hackensack, construct bikeway from Hackensack River to Steuban House to Johnson Park
			Hackensack-Teaneck, construct bikeway from Johnson Park on east side to Hackensack River
			Oradell, construct bikeway link between Commander Black Drive to Ridewood Ave.
			Rivervale, construct bikeway along Rivervale Ave. to link existing bikeways in Rivervale

Region	State	Urban Area	Bicycle Measure
II	N.J.	Bergen	Ramsey, construct bikeway from Darlington/Campgaw Park to meet both Ramapo River and Rockland Electric Utility Bikeways, 5.0 miles
			Mahwah, construct bikeway along Ramapo River and Rockland Electric Utility right-of-way, 7.6 miles
			E. Rutherford-Rutherford, construct bikeway adjacent to Conrail's Erie Lackawanna Line and Carlton Hill branch
			E. Rutherford-Rutherford, construct bikeway adjacent to Conrail's Erie Lackawanna Line from Park Ave. to Riggin Field
			Fort Lee, construct bikeway on top of Palisades from vicinity of G. Washington Bridge to N.Y. St. line, 12 miles
			Ridgewood bikeway
			Teaneck bikeway
			Emerson bikeway
		Essex	Nutley bikeway
			Canterbury Memorial and Yantacaw Brk Park bikeway
		Hudson	Hudson County bikeway System
			Jersey City bikeway connecting Roosevelt Stadium to Lincoln Park
			Countywide, urban bikeways
			First St., Bayonne bikeway construction
			County Park, bikeway construction
			Shore route, Bayonne Park to Veteran Stadium bikeway
			Montclair bikepath
			Nutley bikepath, Kingsland and Memorial Park

Region	State	Urban Area	Bicycle Measure
II	N.J.	Hudson	Bike route, Newark, Weequahic and Branch Brook Parks
			Bikeway, Newark within Branch Brook Park
			Bike parking, Newark bike parking facilities
		Middlesex	Johnson Park bikeway
			Rutgers University bikeway, Piscataway
			Piscataway (Hoes Lane) bikeway
			Victor Crowell Park bikeway
		Mammouth	Shrewsbury Borough bikeways
			Middletown Township bikeway
			Shark River Park bikeway
			Belmar bikeway, S. Belmar
		Mercer	Bikeway, Mercerville-Edinburg Rd., Hamilton & West Windsor Twps.
			Bikeway, Princeton Boro & Princeton Twp.
			Bikeway- various local streets, Princeton Boro
			Princeton Twp. Bikeway System
			Construction of Princeton Twp. Bikeway System
		Morris	County bikeway, Passaic River Park, Passaic/Chatham Twp.
			Bikeway at Patriots Path
			Bikeway, Pequannock (Woodland Park)
			Bikeway, Pequannock
			Bikeway, Passaic River Park
			Bikeway, Morristown

Region	State	Urban Area	Bicycle Measure
II	N.J.	Ocean	Long Beach Blvd. bikeway
			Brick Township bikeway
			Dover Township bikeway
			Lavallette Borough bikeway
			Seaside Heights Borough bikeway
		Passaic	N. Haledon bikeways
		Somerset	Bikeway, Amwell Rd., Cedar Grove to J.F. Kennedy Blvd.
			Bikeway, Bridgewater, Manville, Somerville
			Bikeway, Bernards Township
			Bikeway, Manville Borough
			Bikeway, Franklin County
			Bikeway, Amwell Township
		Union	Cranford Township bikeway
			Passaic River Park bikeway
			46 Transit Terminal bicycle lockers
		DUPRC/ Burlington	Willingboro Township bikeway
			Strawbridge Lake bikeway, Moorestown Township
			Levitt Parkway bikeway, Willingboro Township
			Bikeway system, Willingboro Township
			Moorestown Riverton Road
		Camden	Bikeway along Cooper River, Lawnside Boro
			Bikeways along various local roads, City of Camden

Region	State	Urban Area	Bicycle Measure
III	Pa.	Allegheny County (Pittsburgh)	Bike-n-ride lockers
		Lehigh & Northampton Counties (Allentown-Bethlehem-Easton)	Implementation of Allentown and Easton bikeway studies (Increase in bicycling will reduce hydrocarbon emissions slightly)
		Scranton/ Wilkes-Barre	Bike routes as in the Lackawana County Regional Planning Commission Bike Route Plan, June '78
	Del.	Wilmington	Implementation of bicycle facility improvements. Implementation of Newark bikeway systems, storage facilities and route permission (use Del. Memorial Bridge via truck)
III	Md.	Baltimore	Programs to promote bicycle use for short trips, particularly commuting; handbook for commuters Provide basic bicycle-related roadway improvements (i.e. bike safe storm grates, wide urban lanes, paved shoulders) Pilot bicycle parking, install bike parking at selected sites Establish and expand cyclist and motorist education programs Selected bikeways identified as priority routes in the regional bikeways plan for designation or construction.

Region	State	Urban Area	Bicycle Measure
III	Md.	Howard County	Bikeway/pedestrian bridge
		Montgomery County	Build 17 additional miles of bike lanes and bikeways
			Install 400 additional bike storage facilities
		Rockville	Comprehensive bikeway plan
		Bowie	Bikeways/bike lanes
		City of Gaithersburg	Bike paths to be included in master plan update
	D.C.	D.C.	Bike lanes and bikeways. Install 300 additional bicycle storage facilities
	Va.	Northern Virginia Counties	Bikeway along I-66 corridor between I-495 and Rosslyn in Arlington and Fairfax
		Arlington	Bike storage at metrorail. Fund additional 19.1 miles of bikeways
III	Va.	Loundon	Bike storage at metro
		Falls Church	Bikeway on Gallows Road from Route 29/211 to Route 7, Fairfax
			Bikeway along Route 1 corridor between entrance on Ft. Belvoir and north intersection of Route 235 in Fairfax
		Virginia Beach	Witch Duck Road bikeway, 2.12 miles
			North Plaza Trail bikeway
			Newton Road-Haywood Road bikeway
		Norfolk	Bikeway expansion study of its 20 mile bicycle route system

Region	State	Urban Area	Bicycle Measure
III	Va.	S.E. Virginia	Study to evaluate (1) implementation potential of short bikeways (2.5 to 5.5 miles) to serve all types of trips; (2) promotion of bikeways as a form of transportation for all types of trips; (3) evaluation of cost and benefits of bikeways; (4) implementation of safety programs; (5) construction of secure bike parking with transit and activity centers; and (6) potential of shared bikeways
		Portsmouth	Bikeway along George Washington Highway between Chesapeake City limits and Norfolk Naval Shipyard (will serve as a commuter route for shipyard workers living in Craddock and serve the Town and Country shopping center
		Hampton City/ Newport News	Regional bike plan adopted by MPO Bicycle lockers and shelters at fringe parking lots
IV	Ala.		Bicycle lanes and storage facilities
	Ky.		Bicycle facilities. Further implementation of Regional Bikeway Plan
		Jefferson County	Long range bicycle plans for 500 miles of bikeway network
	Ga.	Atlanta	Atlanta Regional Council preparing summary report, will look at bicycle measures

Region	State	Urban Area	Bicycle Measure
	S.C.	Charleston County	Long range bikeways program, 161.7 miles
		Columbia	Bikeway plan for a comprehensive network of bikeways under guidance of the Bikeway Subcommittee, Columbia Area Transportation Study, Transportation Planning Advisory Committee
	Fla.	Duval County	1979-1982 study to consider implementation of remaining bikeway routes recommended in Jacksonville Urban Area Transportation Study, Regional Bikeway Plan
		Jacksonville	Bikeway Implementation Plan of 110 miles to be implemented 1979-1985. Jacksonville area to initiate bikeway routes in 1979. (The routes will collect bicycle traffic from north, sourth portions of city, and link bicycle commuter traffic to downtown area)
		Pinellas County	Evaluation of bicycle lanes and storage facilities to be completed by 12/81
		Broward County	Bikeways Implementation Plan, 221 miles of Class I bikepaths, 537 miles of Class II bike routes.
			Encourage use of bicycles, especially for short trips. Estimated daily VMT reduction due to bikes: 1982 62,594 mi/day 1987 75,227 mi/day

Region	State	Urban Area	Bicycle Measure
IV	Fla.	Dade County	By 1982 Dade County will have implemented 100 miles of Class I separated bikeways and 200 additional miles of signed routes, plus bike lockers at transit.
		Palm Beach	Bikeway study plan. Bicycle usage will be publicized and taken to large employers for consideration.
		Orange County	Sidewalk and bike path program
V	Ind.	South Bend	Appropriate provisions in future highway projects for bicycles and pedestrians to ensure efficient use of road space
	Minn.	Duluth	Employer programs to encourage bicycling
		Twin Cities	Bicycle facilities
		Rochester	Bikeways as identified in proposed bikeway plan for the Rochester area
	Ohio	Cincinnati	Implemented 1975/78 bicycle facilities in city of Middletown
		Kenton County, Ky.	Bicycle storage facilities and bikeways
		Columbus	Bike lane improvements: Tuttle Park (5,545 ft.), Front & Main Street (4,240 ft.), Bethlet to Whetstone Park (12,000 ft.) Schrock Rd. (400 ft.)
	Wisc.	Madison	Bicycle system improvement 1979-82, goal to improve bike paths

Region	State	Urban Area	Bicycle Measure
V	Ohio	Cleveland	Several bikeways constructed in 1975 metropark system
		Canton	20 mile bikeway plan, 2 routes scheduled for construction in 1979: (1) West to Tuscarawas to Fulton Canton Park system, (2) Maple to Glenwood in North Canton Place Park
	Ill.	Chicago	Development of bikeways and storage facilities (will inventory all facilities), implement local bikeway programs
VI	Texas	Houston	17 miles of bike paths by 1981 (attachment to SIP, not SIP commitment). Study bike paths to determine how to serve commuter traffic.
	N. Mex.	Albuquerque	Bicycle storage at major commercial and public facilities
			Bikeway network master plan part of an approved Transportation Plan. Bikeways are a consideration of all street and highway development and are included as part of the facility design where appropriate
VI	Ark.	Little Rock	Evaluate and study programs for bike lanes and bike storage as part of the TIP development
	Okla.		Evaluate and study programs for bicycle storage and bicycle lanes as part of alternative analysis
VII	Kansas	Wichita	Bicycle lanes and storage facilities, employer programs to encourage bicycling and walking, bicycle lanes and storage and comprehensive bike plan are potential measures which may be pursued if other strategies do not work

Region	State	Urban Area	Bicycle Measure
VIII	Colo.	Denver	Development of Regional Bicycle Plan. Bicycle Plan Implementation and Demonstration Project. Bicycle parking wherever a major employer or major business landlord provides subsidized parking facilities for motor vehicles. 5 year program: bike/pedestrian underpass, 5 bikeways next to major arterials, program to restripe highways to allow for wider outside lanes
IX	Calif.	Los Angeles	Increased bicycle pedestrian facilities (bike paths and bike racks). Amend zoning ordinance to require bike paths, bike racks and over-crossing.
		San Diego	Develop regional bicycle route system, community oriented routes, bicycle feeder systems to public transit, possible employer incentives and facilities, including secure bicycle parking, connections with express bus service, showers and lockers. Extensive educational and promotional programs. (1990 target: 50% increase in bike travel).
		Monterey/ Santa Cruse	Bike lanes and storage facilities
		Santa Barbara	Provide public information on bicycle programs to push existing bicycle system which has bike storage facilities, network of bike routes and bike maps.
		San Francisco	Planning storage facilities, developing bike routes, Transbay Bike Shuttle van/ bike trailer over Bay Bridge
	Nev.	Las Vegas	Increased bicycle use

Region	State	Urban Area	Bicycle Measure
X	Wash.	Vancouver	Additional Bicycle Use, Given medium priority for analysis to attain emission reduction targets
		Seattle-Tacoma	Bicycle lanes and storage, trails and walkways; will be analyzed for emission reduction potential. Plan to accelerate current City of Seattle Bicycle program.
			Bicycle Coordinator: City of Seattle has hired a bicycle coordinator to encourage bicycle use
		Spokane	Bicycle Parking and storage: Employers will be encouraged to provide bicycle parking and storage
			Survey: Survey county employees to determine additional bicycle storage and other needs
			Bikeways/Pathways Plan: Implement recommendations from forthcoming Interim Bikeways/Pathways Plan
	Idaho	Boise	Bike Plan: Improve current bike plan (adopted 1976) to provide for additional bike lanes and storage
			Bicycle Coordinator: Hired by Ada County January 1978
			Bicycle/Pedestrain Design Manual adopted March 1979
			Bikeway Map: Prepare Bikeway Master Map for Ada County (FY 79 UPWP)

Region	State	Urban Area	Bicycle Measure
X	Idaho	Boise	Candidate projects for future consideration: Approximately $2,500 in federal funds will be used to analyze the potential of additional bicycle measures including: 1) Bicycle peer court to hear cases involving traffic violations by younger (high school age and below) riders 2) Push for bike parking facilities 3) Education program on bicycle safety 4) Bicycle commuter marketing program 5) Bikeway maintenance program 6) Getting bicycle projects on the transportation systems element (funding) list
	Oregon	Portland	Bikeways: Have developed 74 miles of bikeways in the air quality maintenance area. Committee to use 1% of state highway funds for bicycle transport. Will receive additional emphasis if other control measures do not bring sufficient reductions in emissions. Map: The City of Portland will prepare a map of city streets, rating each street for difficulty of riding Location study: study of where to put short term (racks and posts) and long term (lockers) bicycle parking to encourage commuting by bicycle to the central business district
		Salem	Bicycle Plan: Bicycle Plan recently completed and undergoing review. Plan will be incorporated into comprehensive and transportation plans.

Region	State	Urban Area	Bicycle Measure
X	Oregon	Eugene-Springfield	Bikeways: Over 100 miles of bikeways currently in metropolitan area. Bicycling encouraged. Significant commuter use of bikeways. Use of bicycles linked to modest emission reductions needed to meet standards.
		Ashland-Medford	Increased Bicycle Use: Produce 700 tons per year CO reduction from improved bicycle and transportation networks. Will receive careful consideration in analysis of transportation control measures (175 grant).

Figure A-2

MAJOR MODE OF TRANSPORTATION TO WORK FOR 22 U.S. SMSAs: 1975, 1976

	SMSA	Foot	Bicycle	Drives Alone	Carpool	Bus[1]	Subway or El.[2]	Train	Other[3]
1.	Allentown-Bethlehem-Easton, Pa.-N.J.	7.9	-	70.5	19.4	1.3	-	-	0.9
2.	Baltimore, Md.	5.1	0.4	61.2	21.5	11.0	-	-	0.8
3.	Birmingham, Ala.	2.6	-	75.6	17.6	2.9	-	-	1.3
4.	Buffalo, N.Y.	5.5	0.9	72.8	13.8	5.0	-	-	2.0
5.	Cleveland, Ohio	3.6	0.4	68.7	13.8	9.6	1.5	-	2.4
6.	Denver, Colorado	5.2	1.2	69.4	17.4	5.2	-	-	1.6
7.	Grand Rapids, Mich.	4.8	1.3	74.9	16.3	1.3	-	-	1.4
8.	Honolulu, Hawaii	4.0	1.0	57.4	25.2	11.4	-	-	1.0
9.	Houston, Tex.	2.7	0.5	70.4	21.6	3.5	-	-	1.3
10.	Indianapolis, Ind.	3.2	0.2	71.3	21.3	3.0	-	-	1.0
11.	Las Vegas, Nev.	2.8	0.7	75.9	17.2	2.1	-	-	1.3
12.	Louisville, Ky.-Ind.	2.4	0.3	72.0	18.9	4.5	-	-	1.9
13.	New York, N.Y.	7.9	0.3	36.3	10.2	11.6	28.0	4.4	1.3
14.	Oklahoma City, Okla.	2.8	0.7	76.4	18.1	0.7	-	-	1.3
15.	Omaha, Nebr.-Iowa	3.9	0.4	68.1	21.1	4.3	-	-	2.2
16.	Philadelphia, Pa.	5.8	0.4	61.8	16.1	9.0	3.2	3.1	0.6
17.	Providence-Pawtucket-Warwick, R.I.-Mass.	5.1	0.3	70.1	20.6	3.4	-	-	0.5
18.	Raleigh, N.C.	2.7	0.9	70.3	23.4	0.9	-	-	1.8
19.	Sacramento, Calif.	2.3	3.2	74.1	16.9	2.0	-	-	1.5
20.	St. Louis, Mo.-Ill.	3.8	0.6	68.3	21.5	4.5	-	-	1.3
21.	San Francisco-Oakland, Calif.	4.8	1.1	61.8	14.5	12.5	0.6	2.7	2.0
22.	Seattle-Everett, Wash.	3.4	0.5	69.1	17.6	8.0	-	-	1.4
	TOTAL, all workers making trips (excluding Phil, Pa. and San Francisco, Cal. SMSAs)	5.1	0.6	59.1	16.4	7.3	8.8	1.4	1.4

[1] Includes streetcars

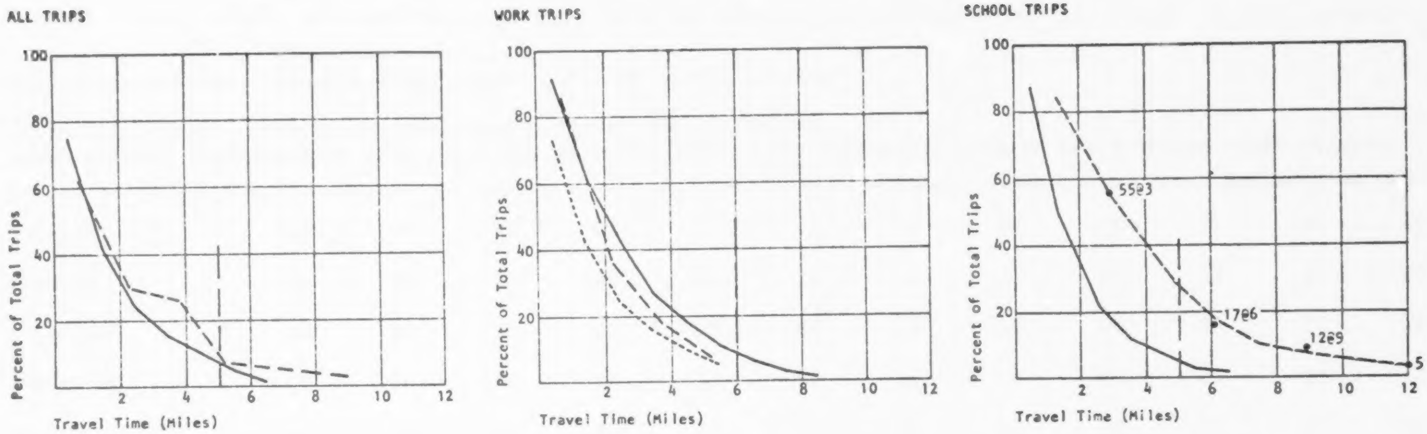
[2] El. = Elevated

[3] Includes workers using motorcycles, all other means not listed, and workers using an auto or truck but not specifying type of riding arrangement.

Source of Data: U.S. Bureau of the Census, Selected Characteristics of Travel to Work in 20 Metropolitan Areas: 1976, P-23, No. 72, Sept. 1978; Selected Characteristics of Travel to Work in the San Francisco-Oakland SMSA: 1975, P-23, No. 88, July 1979; and Selected Characteristics of Travel to Work in the Philadelphia SMSA: 1975, P-23, No. 86, August 1979.

Figure A-3

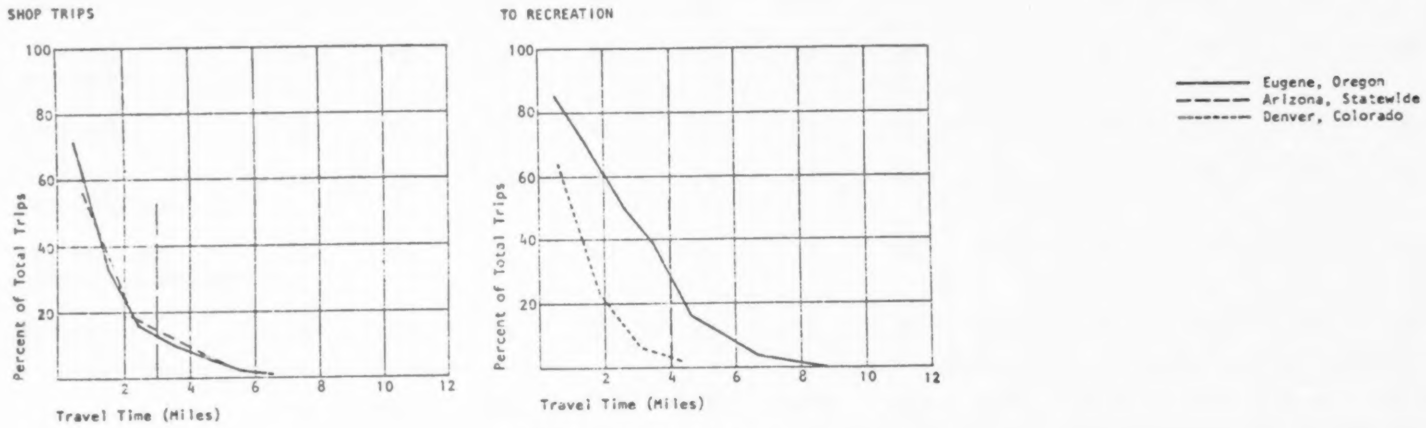
Bicyclist Trip Length - Frequency Distributions



90% of all trips within 5 mile range

90% Trips within 6 miles

70-90% Trips within 5 mile range



80-90% Trips within 3 mile range

75-95% Trips within 4 mile range

Source: Safety and Location Criteria for Bicycle Facilities, Daniel T. Smith Jr., De Leuw, Cather & Company, FHWA-RD-75-112, February 1977, p..59.

COMPARISON OF MEAN MONTHLY TEMPERATURE IN EUROPEAN CITIES WITH HIGH LEVELS OF BICYCLE USE AND SELECTED U.S. CITIES

MEAN MONTHLY TEMPERATURE - °F

	Jan.	Feb.	Mar.	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
*London	40	40	41	55	53	56	63	61	56	53	42	44
*DeBilt, Netherlands (Rotterdam)	36	39	37	46	52	58	63	63	56	51	42	42
*Stockholm (Upsala, Sweden)	31	30	29	38	53	59	64	61	52	48	34	35
*Copenhagen	34	36	34	44	56	58	65	64	56	50	41	41
*Sacramento (Davis)	45	48	52	56	62	70	76	77	72	61	53	43
Minneapolis	12	16	27	44	57	67	72	70	60	49	31	18
Milwaukee	21	22	31	44	53	63	69	68	60	50	36	25
Erueka, Calif.	47	48	49	50	53	56	56	57	56	54	51	49
New Haven	30	30	37	47	57	66	72	71	64	54	43	32
Cleveland	28	29	35	47	58	68	72	70	64	53	41	31
Boston	30	30	38	48	59	68	74	72	65	55	45	33
Buffalo	25	24	32	44	55	65	70	68	61	51	39	28

*From Monthly Climatic Data from the World National Oceanic and Atmospheric Admin. Environmental Data Service. Volume 24, 1971. These have been rounded off to nearest degree.

1973 World Almanac - Monthly Normal Temp. based on data 1931-1960.

Source: C.E. Ohrn, "Estimating Potential Bicycle Use and Public Investment", (Minneapolis, Minn.: Barton-Aschman Associates Inc.), August 22, 1973.

Figure A-5

CRUDE ESTIMATES OF THE RISKS OF TRAVEL BY VARIOUS MODES

Mode	Deaths per 100 million miles[a]	Risk Relative to driving (times more dangerous)
Rapid Transit	0.06	
Scheduled passenger plane	0.1	
Bus	0.2	
Passenger train	0.2	
Car	1.5 - 5[b]	
Motorcycle	11.0 - 20[b]	3 - 10
General private aviation	15.0	5 - 10
Bicycle	15-30[b,c]	3 - 10
Dutch		3.5-6[d]
English		10.0[e]
Pedestrian	20-40	10 - 20

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[a] Unless otherwise noted the estimates are from William Haddon, Jr., M.D., and Susan P. Baker, M.P.H., "Injury Control," in Duncan Clark and Brian Mac Mahon (eds.), Preventive Medicine, 2d edition (Boston: Little, Brown and Company, 1976), Table 2.

[b] National Safety Council, Accident Facts (1969) for highside estimates.

[c] Author's crude estimates from data in table and other calculations.

[d] Personal letter (10 October 1977) from G.R. de Reft, Eng., Manager Traffic Engineering & Safety Department, ANWB (Royal Dutch Touring Club), The Hague; personal letter (2 August 1977) with documentation from ir.T. Mulder, Head of the Traffic Bureau, Amsterdam, Netherlands; and personal letter (10 May 1977) from H. v.d. Klei, Information Department, Institute for Road Safety Research SWOV, Voorburg, Netherlands.

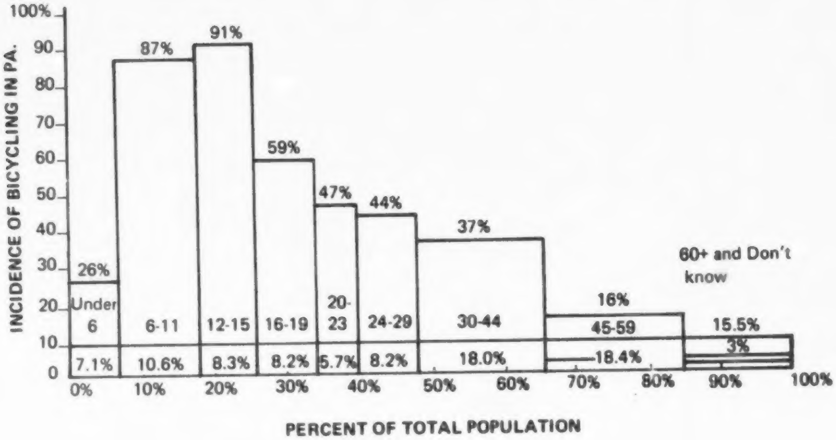
[e] J.D.G.F. Howe, "The Issue of Safety in Planning for the Cyclist," The Highway Engineer, March 1977, pp. 16-17 (footnotes), and Friends of the Earth Ltd., "Bicycles Campaign Briefing Document No. 4" (London) quotes and critiques the official statistics of 10 times as much risk of a fatal accident cycling as driving.

Source: M. Everett, University of Tennessee, 1979.

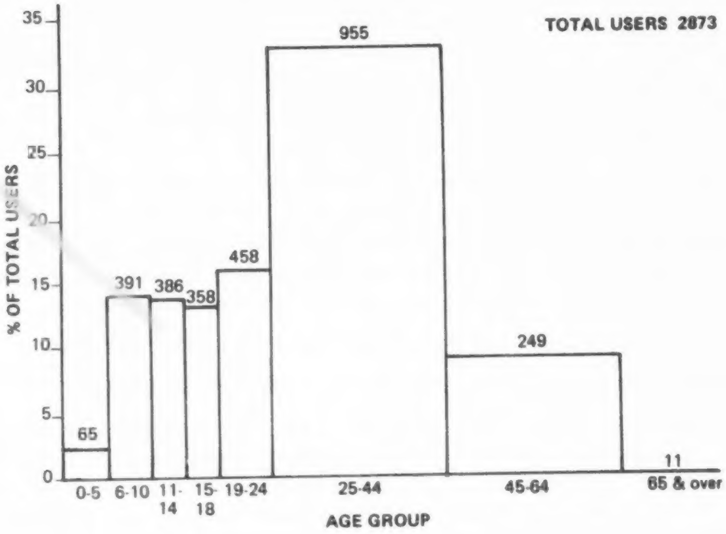
Figure A-6

STATE OF PA. AND MADISON AREA BICYCLE USERS BY AGE GROUPS

STATE OF PA.[1]



MADISON AREA[2]



Sources: [1] **Bicycling in Pennsylvania**, (Barton-Aschman Associates Inc. for the State of Pennsylvania), March 1976.

[2] **Technical Memorandum III, Survey and Inventory, Findings and Implications** (Madison, Wisconsin: City of Madison), 1974.

APPENDIX B

EPA BICYCLE COORDINATORS, REGIONAL OFFICES, AND STATES IN REGION

Region	Bicycle Coordinator	States in Region
I	Denny Lawton Environmental Protection Agency Room 2302 JFK Federal Bldg. Boston, Massachusetts 02203 FTS 8-223-5630 617-223-5630	Connecticut, Maine, Massachusetts, New Hampshire, Rhode Island, Vermont
II	John Filippelli Environmental Protection Agency Room 1005 26 Federal Plaza New York, New York 10007 FTS 8-264-7665 212-264-7665	New Jersey, New York Puerto Rico, Virgin Islands
III	Peter Cosier/Bill Belanger Environmental Protection Agency 6th & Walnut Streets Philadelphia, Pennsylvania 19106 FTS 8-886-6082 321-886-6082	Delaware, Maryland, Pennsylvania Virginia, West Virginia, District of Columbia
IV	Don Stone Environmental Protection Agency 245 Courtland Street, N.E. Atlanta, Georgia 30308 FTS 257-2864 404-881-2864	Alabama, Georgia, Florida, Mississippi, North Carolina, South Carolina, Tennessee, Kentucky
V	Michelle Rockawich Environmental Protection Agency Air Pollution Division 230 S. Dearborn Street Chicago, Illinois 60604 FTS 8-886-6082 215 886-6082	Illinois, Indiana, Ohio Michigan, Wisconsin, Minnesota
VI	Ragan Broyles Environmental Protection Agency 1201 Elm Street Dallas, Texas 75270 FTS 8-729-2742 214-767-2742	Arkansas, Lousisana Oklahoma, Texas, New Mexico
VII	Wayne Leidwanger Environmental Protection Agency Room 249 1735 Baltimore Avenue Kansas City, Missouri 64108 FTS 8-758-2880 816-374-2880	Iowa, Kansas, Missouri, Nebraska

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Region	Bicycle Coordinator	States in Region
VIII	Barry Levene Environmental Protection Agency Suite 900 1860 Lincoln Street Denver, Colorado 80203 FTS 8-327-3711 303-837-3711	Colorado, Utah, Wyoming, Montona, North Dakota, South Dakota
IX	Eric Ginsburg Environmental Protection Agency 215 Fremont Street San Francisco, California 94105 FTS 8-556-2498 415-556-2498	Arizona, Californai, Nevada Hawaii
X	Dave DeBryun Environmental Protection Agency 1200 Sixth Avenue Seattle, Washington 98101 FTS 8-399-1226 206-442-1226	Alaska, Idaho, Oregon, Washington
EPA Headquarters	Nina Rowe Environmental Protection Agency ANR-445 401 M. Street, S.W. Washington, D.C. 20460	

APPENDIX C

ILLUSTRATIVE FACILITY COSTS

- Average Bike Route, Lane and Path Costs
- Bicycle Parking Facility Costs

NOTE: All illustrative facility costs except bicycle storage facilities are based on 1974 data as summarized in A. Sorton, R.K. Seyfried, and L.J. Slade's Pedestrian and Bicycle Considerations in Urban Areas: An Overview: (conducted for the U.S. Department of Transportation, Federal Highway Administration and National Highway Safety Administration by the Traffic Institute, Northwestern University, in cooperation with Barton-Aschman Associates, Inc.) Dec. 1977. These costs have been adjusted to reflect more current figures. A factor of .477 has been used which is based on the U.S. Bureau of Labor Statistics' Consumer Price Index, which rose 47.7% between 1974 and 1979. The original data was from Tennessee, except for summary bicycle costs which were from Pennsylvania and Austin, Texas.

The bicycle parking facilities cost data are from the U.S. General Services Administration's "Bicycle Parking" issuance of June 1, 1979. These costs have been included to provide a rough approximation of cost order-of-magnitude. They cannot substitute in any way for local information needed for accurate area-specific cost estimates, because of regional variations and rapidly changing prices.

SUMMARY OF BICYCLE FACILITY COSTS

TYPE	AVERAGE INSTALLATION COSTS (Cost Per Mile)	AVERAGE MAINTENANCE (Costs/Mile/Year)
BICYCLE ROUTE	$739-$1,477	$300
BICYCLE LANE	$1,477-$4,431	$600
BICYCLE PATH	$29,540-$88,620	$1,000

SOURCE: BARTON-ASCHMAN ASSOCIATES INC.

Bicycling in Pennsylvania

Recommended State Policies for Providing Bicycle Facilities Programs 1975

AUSTIN AREA BICYCLE SYSTEM
INTERIM REPORT, AUSTIN, TEXAS 1975

PAVEMENT SURFACE

	Asphalt Concret Full Depth		Asphalt Con. Surface With Stabilized Base		Cement Surf. With Stab. Base		Stabilized Gregate	
WIDTH	PER 100'*	PER MILE	PER 100'	PER MILE	PER 100'	PER MILE	PER 100'	PER MILE
8	$606-871	$31997-45936						
8			$542-672	$27667-35482				
8					$1580-1699	$83424-89707		
8							$487-635	$25714-33528
10.5	$768-1078	$40550-56918						
10.5			$665-798	$35112-42134				
10.5					$1920-2053	$101376-103398		
10.5							$635-812	$33528-42874
12.5	$916-1285	$48365-67848						
12.5			$827-1019	$43666-53803				
12.5					$2275-2467	$120120-130253		
12.5							$753-960	$39758-50688

NOTE: SURFACING COSTS REFLECT INCIDENTAL CLEARING AND CURBING, REDUCED MATERIAL COST ALLOWANCE FOR INCREASE QUANTITIES, AVERAGE OF TWO FEET EXCAVATION THROUGHOUT.

* 100 Linear Feet

BICYCLE PARKING FACILITIES

Name of Device	Manufacturer Address	Class[1]	Model	Price	Notes
Cycle-Safe System	Hartger & Hartger 143 Ionia Ave., Grand Rapids, MI 49503 (616) 459-4556	I	I	$320 per Locker $160 per Bicycle	• Double compartmented Bicycle Locker • Holds two bicycles stored horizontally and facing in opposite directions • Reinforced fiberglass top and sides • Totally enclosed to protect bikes from the weather • Access from both ends of locker
Bike Stable	Bike Stable Co. P.O. Box 1402 South Bend, IN 46624 (219) 233-7060	I	Key-Oper.	$214 per Locker $214 per bicycle	• Bicycle Locker • Holds one bicycle stored vertically • Totally enclosed to protect bikes from the weather • Shroud covered padlock • Minimum order is 100 units • Vertical storage of bike may present problems for cyclist

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[1] Class I provides totally enclosed protection from weather and maximum protection from theft or vandalism. Class II is not enclosed and provides security by locking both wheels and frame. The bicyclist is generally required to provide a lock.

Name of Device	Manufacturer - Address	Class	Model	Price	Notes
Bike Lokr	Bike Lockers East 1051 Pennsylvania Ave., Tyrone, PA 16686 (814) 684-4108 Bike Lockers, LTD. P.O. Box 445 West Sacramento CA 95691 (916) 372-6620	I	M-2	$390 per Locker $195 per Bicycle	• Standard double compartmented bicycle locker • Holds two bicycles stored horizontally and facing in opposite directions • Aluminum welded frame with 5/8 in. phenolic particle board side, top, and doors • Barrel bolt lock for hasp type lock • Totally enclosed to protect bikes from the weather • Access from both ends of locker
Park 'n' Lock Bike Garage	J.G. Wilson Corp. P.O. Box 599 Norfolk, VA 23501 Representative: Graham, Van Lear & Elmore Co., Inc. 8453-A Tyco Road Tysons Corner Vienna, VA (703) 821-8990	I	TM-22-BG	$1,015 per Locker $508 per Bicycle	• Double bicycle locker • Holds two bicycles stored horizontally in separate stalls and facing in the same direction • Each stall has a counterbalanced steel shutter with provision for locking • Totally enclosed to protect bikes from the weather • Enclosure frame consists of side, top, back, and bottom panels • Panels fabricated from galvanized steel • Access from one end of locker

Name of Device	Manufacturer - Address	Class	Model	Price	Notes
Park-A-Bike	Park-A-Bike, Inc. 280 Madison St. Denver, CO 80206 (303) 355-5316	II	-	$25 per rack	• Bicycle security rack • Available in single units • Secures both wheels and frame with a single lock • Relatively easy to use • Employs a curved steel arm that swings over the bike frame and clamps around it • Cable which secures both wheels may be vulnerable to bolt or wire cutters
Petal Park	Petal Park 9226 Annapolis Td. Lanham, MD 20801 (301) 459-1722	II	P-100 (Pad-Lock) K-200 (Key assign.)	$138.75 per rack $69.38 per bicycle $219.25 per rack $109.63 per bicycle	• Bicycle security rack • Each rack holds two bicycles • All steel construction • One movable part • Secures the wheels and frames of most bikes with a swing arm in lieu of chains or cables • Has a polyurethane coating to protect against corrosion • Aesthetically pleasing

Name of Device	Manufacturer - Address	Class	Model	Price	Notes
Rally Rack	Rally Enterprises, Inc. P.O. Box 299 Sonoma, CA 95476 (707) 938-4744	II	RR-200	$27 per rack $27 per bicycle	• Bicycle security rack • Holds one bicycle • Secures rear wheel and frame with a single lock • Increases protection with the addition of a cable attached to the post which secures the front wheel • Cable may be vulnerable to bolt or wire cutters
		II	RR-300	$60 per rack $60 per bicycle	• Bicycle security rack • Holds one bicycle • Secures rear wheel and frame with a single lock • Eliminates cable and adds a separate aluminum chassis which prevents removal of the front wheel • Company claims front wheel cannot be removed from chassis while back wheel is held in place by the locked parking stand

Name of Device	Manufacturer - Address	Class	Model	Price	Notes
Rack III	Rack III 3661 Grand Ave. Oakland, CA 94610 (415) 835-8058	II	Pad-lock	$96.50 per two bike module	● Bicycle security rack ● Holds two bicycles per module ● Secures both wheels and frame ● All locking components are constructed of steel ● Secures bike with a pivoting three-pronged device ● This moving part may be troublesome ● Slight inconvenience in removing lock from protective cage
U-LOK	Sunshine Recreation Co. 22713 Ventura Blvd., Suite A Woodland Hills, CA 91364 (213) 884-1732	II	U-LOK Stand	$47.50 per stand $23.75 per bicycle	● Bicycle security rack ● Holds two bicycles ● Has sufficient coated cable to secure both wheels as well as bike frame ● Special U-LOK plug locks bike frame within locking station ● Bicyclist may lose the U-LOK plug ● Cable may be vulnerable to bolt or wire cutters
			U-LOK Plug	$10.50 per Stand $5.25 per Bicycle	

Name of Device	Manufacturer - Address	Class	Model	Price	Notes
Bike-Safe	Patterson-Williams P.O. Box 4040 Santa Clara, CA 95054 (408) 988-3066	II	161 502	$130 per two bike unit $65 per bicycle	• Bicycle security rack • Model 161502 holds two bicycles • Model 161505 holds five bicycles • All galvanized steel • Locks complete bicycle, including frame and both wheels • Not vulnerable to bolt cutters and requires no chain because bike is totally secured as well as surrounded by heavy duty steel pipe • Unaesthetic • Relatively easy to use
			161 505	$250 per five bike unit	

APPENDIX D

- Model Statute or Ordinance
- Sections of the Uniform Vehicle Code Relating to Bicycle Use
- Summary of the Bicycle Provisions, Revised Palo Alto, California Zoning Regulations

STATUTORY OR ORDINANCE CITATION

(CHAPTER NO.; ARTICLE NO.)

AN ACT AUTHORIZING A PROGRAM OF BICYCLE AND BIKEWAY PLANNING AND IMPLEMENTATION

(MODEL STATUTE OR ORDINANCE)

Section 1. Purpose: The purpose of this statute shall be to authorize the (State, City) Department of ( ) to plan and implement a program for the construction, operation and maintenance of a system of bicycle facilities and intermodal links; to undertake a program of public education and information regarding safe bicycling, bicycle facilities and routes; to implement a program for enforcement of safe bicycling and related motor vehicle practices; and to authorize the expenditure of funds for this purpose.

Section 2. Findings: The (Legislature, City Council) hereby finds that:

a) it is in the public interest, health, safety and welfare for the (State, City) to encourage and provide for the efficient and safe use of the bicycle;

b) in order to promote balanced transportation, to increase safety on the public roads and to serve the increasing numbers of bicyclists, it is necessary to construct, operate and maintain bicycle-related facilities and to educate the public with regard to their use;

c) it is necessary to incorporate public and private sector involvement in the planning and implementation of a bicycle and bikeway planning and implementation program;

d) to coordinate plans for bicycle facilities and bicycle use most effectively with other governmental agencies, as they affect roads, streets, schools, parks and other publicly owned lands, abandoned road and railroad beds, and conservation areas, it is necessary to assign responsibility and provide funds to a single (state, city) agency for this purpose, and

e) to maximize the use of public tax dollars, it is necessary to designate a single (state, city) agency which shall be eligible to receive federal matching funds for the purpose of establishing and maintaining a (state-city-) wide bicycle use and bicycle facility planning and implementation program.

f) the separation of bicycle traffic from motor vehicle traffic will increase the traffic capacity and safety of the highway and constitute a highway purpose which justifies the expenditure of highway funds for a bicycle use and bicycle facility planning and implementation program.

Section 3. Definitions: As used in this (statute, ordinance), except where the context clearly requires otherwise, the following words and expressions shall be defined as follows:

a) Bicycle: a non-motorized vehicle with two or three wheels tandem, a steering handle, one or two saddle seats, and pedals by which the vehicle is propelled exclusively by human power.

b) Bikepath: a completely separate and independent travel corridor for the exclusive use of bicycles, either within an existing right-of-way, or in a completely new right-of-way.

c) Bikelane: a portion of an existing road set aside for exclusive bicycle use, delineated by visual barriers.

d) Bikeroute: a travel route consisting of a combination of bikepaths, bikelanes and automobile roads which is appropriately constructed, maintained and designated by signs, markers or other designations.

e) Bicycle facilities: those structures, spaces, or equipment necessary for or incident to the movement, transfer, storage, parking or security of bicycles or bicycle-use, including but not limited to: bikepaths, bikelanes, bikeroutes, bicycle signs, signals, pavement markings, bicycle-safe grates, lighting, transfer stations, bicycle parking lots, rooms, racks and lockers, bicycle education materials and route maps, and bicycle registration systems.

g) Department: the (State, City) Department of ( )

Section 4. Administering Agency and Appointment of Bicycle Coordinator: The (State, City) Department of ( ) is hereby designated and authorized to develop, coordinate and implement a program relating the bicycle use and facility planning and implementation in (State, City), as described in sections 5 and 6, herein. The Department shall appoint an individual to act as coordinator of bicycle programs, to oversee the Department's implementation of the program specified herein, and to coordinate the activities of other agencies, levels of government, individuals, and private organizations for purposes of bicycle use and facility planning and implementation.

Section 5. Program Requirements: The Bicycle Use and Bicycle Facility planning and implementation program shall consist of, but not be limited to:

a) preparation of an overall program plan for the location, construction, operation and maintenance of a system of bicycle facilities and programs through the (State, City) including studies of existing and future users and potential modal shift in vehicle miles, and a plan to establish and implement information exchange, public education, and enforcement of bicycle-related rules and regulations in furtherance of the objectives of such plan.

b) development of standards for planning, designing, construction, maintaining, operating, and marking of bicycle facilities consistent with any established federal standards, and preparation of plans, feasibility studies and detailed designs for the construction of bicycle facilities identified as components of the (state-, city-) wide bikeway system.

c) acquisition of property for, and designation, construction, operation and maintenance of a system of bicycle facilities throughout (State, City).

d) carrying out programs for information exchange, public education and employer programs and facilities for employee bicycle use.

e) developing and publishing policies, procedures, rules and regulations for bicycle and bicycle facility use, and for bicycle registration and security and providing for the enforcement thereof,

f) preparing, publishing, and disseminating educational materials and (state-, city-) wide bikeway route network maps,

g) development and implementation of a bicycle safety enforcement program, administered by the police department.

h) developing and implementing a comprehensive bicycle use and safety education program for children and adults through schools, the media, and other organizations.

i) assistance and cooperation with other units of government and other agencies in the development and construction of state, regional and local bikeways and bicycle-related facilities, and working with elected officials, and citizen groups in planning such bikeway systems.

(for states) only

i) upon the request of a substate unit of government, the Department may enter into an agreement with such governmental unit for the acquisition of property, or the construction, operation and maintenance of bicycle facilities which generally follow a state highway right-of-way where the Department finds that such a facility will not constitute a safety hazard or interfere with the normal flow of traffic.

The costs of the acquisition of property for, or the construction, operation or maintenance of such bicycle facilities shall be apportioned equitably between the Department and the governmental unit.

j) prior to the end of each fiscal year, the Department shall prepare and submit an annual report to the (Legislature, City Council). The annual report shall describe the progress made by the Department in implementing the program requirements described herein.

Section 6: Designation of Bicycle Facility Routes

a) Bicycle facility routes may be designated along and upon the public roads.

b) The Department shall not construct a highway which will result in the severance or destruction of an existing bicycle facility route, unless a reasonable alternative route is provided.

c) The Department shall incorporate bicycle facility plans, prepared pursuant to Section 5, in the design, planning, and construction of all new highways.

Section 7: Authorization:

a) The Department may enter into such agreements, execute such contracts, establish and manage such accounts or deposits, or take any other action that may be appropriate, to apply for, receive and expend funds from the federal, state or local government or private sources available for bicycle programs and projects or related thereto and to accomplish the purposes set forth in preceeding Section 1, 2 and 5.

b) The (Legislature, City Council) hereby authorizes the Department to request needed funds for the bicycle program in its annual budget request. An amount not less than ___________ shall be authorized each year subject to the appropriation of the (Legislature, City Council).

SECTIONS OF THE UNIFORM VEHICLE CODE
RELATING TO BICYCLE USE

Chapter 1 - Words and Phrases Defined

1-105 BICYCLE. Every vehicle propopelled solely by human power upon which any person may ride, having two tandem wheels, except scooters and similar devices.

1-114 DRIVER. Every person who drives or is in actual physical control of a vehicle.

1-184 VEHICLE. Every device in, upon or by which any person or property is or may be transported or drawn upon a highway, excepting devices used exclusively upon stationary rails or tracts. (A bicycle is a vehicle.)*

Chapter 3 - Certificates of Title and Registration of Vehicles

3-102 EXCLUSIONS. No certificate of title need be obtained for: 5.A vehicle moved solely by human or animal power.

Chapter 4 - Anti-theft Laws

4-101 EXCEPTIONS FROM PRIVISIONS OF THIS CHAPTER. This chapter does not apply to the following unless a title or registration has been issued on such vehicles under this act: 1. A vehicle moved solely by human or animal power.

Chapter 7 - Financial Responsibility

7-103 EXEMPT VEHICLES. The following vehicles and their drivers are except from this article: 7. A vehicle moved solely by human or animal power.

Chapter 9 - Civil Liability

9-401 NEGLIGENCE OF CHILDREN. A violation of any provision of this act by a child under the age of 14 shall not constitute negligence per se although a violation may be considered as evidence of negligence.

Chapter 11 - Rules of the Road

11-313 RESTRICTIONS ON USE OF CONTROLLED-ACCESS ROADWAY. (a) The (State highway commission) by resolution or order entered in its minutes, and local authorities by ordinance, may regulate or prohibit the use of any controlled-access roadway (or highway) within their respective jurisdictions by any class or kind of traffic which is found to be incompatible with the normal and safe movement of traffic.

(b) The (State highway commission) or the local authority adopting any such prohibition shall erect and maintain official traffic-control devices on the controlled-access highway on which such prohibitions are applicable and when in place no person shall disobey the restrictions stated on such devices.

*Bicycles were included in the definition of "vehicle" at the National Committee on Uniform Traffic Laws and Ordinances meeting, July 23-25, 1975.

11-504 DRIVERS TO EXERCISE DUE CARE. Notwithstanding other provisions of this chapter or the provisions of any local ordinance, every driver of a vehicle shall exercise due care to avoid colliding with any pedestrian or any person propelling a human powered vehicle and shall give an audible signal when necessary and shall exercise proper precaution upon observing any child or any obviously confused, incapacitated or intoxicated person.

11-509 PEDESTRIANS' RIGHT OR WAY ON SIDEWALKS. The driver of a vehicle crossing a sidewalk shall yield the right of way to any pedestrian and all other traffic on the sidewalk.

11-1103 DRIVING UPON SIDEWALK. No person shall drive any vehicle other than by human power upon a sidewalk or sidewalk area except upon a permanent or duly authorized temporary driveway.

11-1105 OPENING AND CLOSING VEHICLE DOORS. No person shall open any door on a motor vehicle unless and until it is reasonably safe to do so and can be done without interfering with the movement of other traffic, nor shall any person leave a door open on a side of a vehicle available to moving traffic for a period of time longer than necessary to load or unload passengers.

Article XII - Operation of Bicycles and Other Human-Powered Vehicles

11-1201 EFFECT OF REGULATIONS. (a) It is a misdemeanor for any person to do any act forbidden or fail to perfrom any act required in this article.

(b) The parent of any child and the guardian of any ward shall not authorize or knowingly permit any such child or ward to violate any of the provisions of this act.

11-1202 TRAFFIC LAWS APPLY TO PERSONS ON BICYCLES AND OTHER HUMAN-POWERED VEHICLES. Every person propelling a vehicle by human power or riding a bicycle shall have all of the rights and all of the duties applicable to the driver of any other vehicle under chapters 10 and 11, except as to special regulations in this article and except as to those provision which by their nature can have no application.

11-1203 RIDING ON BICYCLES. No bicycle shall be used to carry more persons at one time than the number for which it is designed or equipped, except that an adult rider may carry a child securely attached to his person in a back pack or sling.

11-1204 CLINGING TO VEHICLES. (a) No person riding upon any bicycle, coaster, roller skates, sled or toy vehicle shall attach the same to himself to any (streetcar or) vehicle upon a roadway.

(b) This section shall not prohibit attaching a bicycle trailer or bicycle semitrailer to a bicycle if that trailer or semitrailer has been designed for such attachment.

11-1205 RIDING ON ROADWAYS AND BICYCLE PATHS.[1] (a) Every person operating a bicycle upon a roadway shall ride as near to the right side of the roadway as practicable, exercising due care when passing a standing vehicle or one proceeding in the same direction.

(b) Persons riding bicycles upon a roadway shall not ride more than two abreast except on paths or parts or roadways set aside for the exclusive use of bicycles. Persons riding two abreast shall not impede the normal and reasonable movement of traffic and, on a laned roadway, shall ride within a single lane.

(c) Wherever a useable path for bicycles has been provided adjacent to a roadway, bicycle riders shall use such path and shall not use the roadway.

11-1206 CARRYING ARTICLES. No person operating a bicycle shall carry any package, bundle or article which prevents the use of both hands in the control and operation of the bicycle. A person operating a bicycle shall keep at least one hand on the handlebars at all times.

11-1207 LEFT TURNS. (a) A person riding a bicycle intending to turn left shall follow a course described in 11-601 or in subsection (b).

(b) A person riding a bicycle intending to turn left shall approach the turn as close as practicable to the right curb or edge of the roadway. After proceeding across the intersecting roadway, the turn shall be made as close as practicable to the curb or edge of the roadway on the far side on the intersection. After turning, the bicyclist shall comply with any official traffic control device or police officer regulating traffic on the highway along which he intends to proceed.

(c) Notwithstanding the foregoing provisions, the state highway commission and local authorities in their respective jurisdictions may cause official traffic-control devices to be placed and thereby require and direct that a specific course be traveled by turning bicycles, and when such devices are so placed, no person shall turn a bicycle other than as directed and required by such devices.

11-1208 TURN AND STOP SIGNALS. (a) Except as provided in this section, a person riding a bicycle shall comply with 11-604.

(b) A signal of intention to turn right or left when required shall be given continuously during not less than the last 100 feet traveled by the bicycle before turning, and shall be given while the bicycle is stopped waiting to turn. A signal by hand and arm need not be given continuously if the hand is needed in the control or operation of the bicycle.

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[1] This section was amended during the 1979 meeting of the National Co-mittee on Uniform Traffic Laws and Ordinances. See the end of this document for a draft version of the new amendments.

11-1209 BICYCLES AND HUMAN-POWERED VEHICLES ON SIDEWALKS. (a) A person propelling a bicycle upon and along a sidewalk, or across a roadway upon and along a crosswalk, shall yield the right of way to any pedestrian and shall give audible signal before overtaking and passing such pedestrian.

(b) A person shall not ride a bicycle upon and along a sidewalk, or across a roadway upon and along a crosswalk, where such use of bicycles is prohibited by official traffic-control devices.

(c) A person propelling a vehicle by human power upon and along a sidewalk, or across a roadway upon and along a crosswalk, shall have all the rights and duties applicable to a pedestrian under the same circumstances.

11-1210 BICYCLE PARKING. (a) A person may park a bicycle on a sidewalk unless prohibited or restricted by an official traffic control device.

(b) A bicycle parked on a sidewalk shall not impede the normal and reasonable movement of pedestrian or other traffic.

(c) A bicycle may be parked on the roadway at any angle to the curb or edge of the roadway at any location where parking is allowed.

(d) A bicycle may be parked on the roadway abreast of another bicycle or bicycles near the side of the roadway at any location where parking is allowed.

(e) A person shall not park a bicycle on a roadway in such a manner as to obstruct the movement of a legally parked motor vehicle.

(f) In all other respects, bicycles parked anywhere on a highway shall conform with the provisions of article 10 regulating the parking of vehicles.

11-1211 BICYCLE RACING. (a) Bicycle racing on the highways is prohibited by 11-808 except as authorized in this section.

(b) Bicycle racing on a highway shall not be unlawful when a racing event has been approved by state or local authorities on any highway under their respective jurisdictions. Approval of bicycle highway racing events shall be granted only under conditions which assure reasonable safety for all race participants, spectators and other highway users, and which prevent unreasonable interference with traffic flow which would seriously inconvenience other highway users.

(c) By agreement with the approving authority, participants in an approved bicycle highway racing event may be exempted from compliance with any traffic laws otherwise applicable thereto, provided that traffic control is adequate to assure the safety of all highway users.

Chapter 12 - Equipment of Vehicles

12-101 SCOPE AND EFFECT OF REGULATIONS. (e) The provisions of this chapter and regulations of the department shall not apply to vehicles moved solely by human power, except as specifically made applicable.

12-201 WHEN LIGHTED LAMPS ARE REQUIRED. Every vehicle upon a highway within this State at any time from a half hour after sunset to a half hour before sunrise and at any other time when, due to insufficient light or unfavorable atmospheric conditions, persons and vehicles on the highway are not clearly discernable at a distance of 1,000 feet ahead shall display lighted head and other lamps and illuminating devices as respectively required for different classes of vehicles, subject to exceptions with respect to parked vehicles, and further that stop light, turn signals and other signaling devices shall be lighted as prescribed for the use of such devices.

Article VII - Bicycles

12-701 APPLICATION OF CHAPTER TO BICYCLES. No provision in this chapter shall apply to bicycles nor to equipment for use on bicycles unless a provision has been made specifically applicable to bicycles or their equipment.

12-702 HEAD LAMP REQUIRED AT NIGHT. Every bicycle in use at the times described in 12-201 shall be equipped with a lamp on the front emitting a white light visible from a distance of at least 500 feet to the front.

12-703 REAR REFLECTOR REQUIRED AT ALL TIMES. Every bicycle shall be equipped with a red reflector of a type approved by the department which shall be visible for 600 feet to the rear when directly in front of lawful lower beams of head lamps on a motor vehicle.

12-704 SIDE REFLECTOR OR LIGHT REQUIRED AT NIGHT. Every bicycle when in use at the times described in 12-201 shall be equipped with reflective material of sufficient size and reflectivity to be visible from both sides for 600 feet when directly in front of lawful lower beams of head lamps on a motor vehicle, or, in lieu of such reflective material, with a lighted lamp visible from both sides from a distance of at least 500 feet.

12-705 ADDITIONAL LIGHTS OR REFLECTORS AUTHORIZED. A bicycle or its rider may be equipped with lights or reflectors in addition to those required by the foregoing sections.

12-706 BRAKE REQUIRED. Every bicycle shall be equipped with a brake or brakes which will enable its driver to stop the bicycle within 25 feet from a speed of 10 miles per hour on dry, level, clean pavement.

12-707 SIRENS AND WHISTLES PROHIBITED. A bicycle shall not be equipped with, nor shall any person use upon a bicycle, any siren or whistle.

12-708 BICYCLE IDENTIFYING NUMBER. A person engaged in the business of selling bicycles at retail shall not sell any bicycle unless the bicycle has an identifying number permanently stamped or cast on its frame.

12-709 INSPECTING BICYCLES. A uniformed police officer may at any time upon reasonable cause to believe that a bicycle is unsafe or not equipped as required by law, or that its equipment is not in proper adjustment or repair, require the person riding the bicycle to stop and submit the bicycle to an inspection and such test with reference thereto as may be appropriate.

Chapter 15 - Respective Powers of State and Local Authorities

15-101 PROVISIONS UNIFORM THROUGHOUT STATE. The provisions of this act shall be applicable and uniform throughout this State and in all political subdivisions and numicipalities therein and no local authority shall enact or enforce any ordinance on a matter covered by the provisions of such chapters unless expressly authorized.

15-102 POWERS OF LOCAL AUTHORITIES. (a) The provisions of this act shall not be deemed to prevent local authorities with respect to streets and highways under their jurisdiction and within the reasonable exercise of the police power from:

8. Regulating the operation of bicycles and requireing the registration and inspection of same, including the requirement of registration fee.

Source: National Committee on Uniform Traffic Laws and Ordinances, Uniform Vehicle Code, main volume, 1968 and supplement, 1976 (Washington, D.C.) as summarized in Model Bicycle Ordinance, American Automobile Association, 1976.

1979 DRAFT AMENDMENTS TO SECT. 11-1205[1]

11-1205 POSITION ON ROADWAY (Riding on roadways and bicycle paths).

(a) Any person operating a bicycle upon a roadway at less than the normal speed of traffic at the time and place and under the conditions then existing shall ride as close as practicable to the right-hand curb or edge of the roadway except under any of the following situations:

(1) When overtaking and passing another bicycle or vehicle proceeding in the same direction.

(2) When preparing for a left turn at an intersection or into a private road or driveway.

(3) When reasonably necessary to avoid conditions including, but not limited to, fixed or moving objects, parked or moving vehicles, bicycles, pedestrians, animals, surface hazards, or substandard width lanes that make it unsafe to continue along the right-hand curb or edge. For purposes of this section, a "substandard width lane" is a lane that is too narrow for a bicycle and a vehicle to travel safely side by side within the lane.

(b) Any person operating a bicycle upon a one-way highway with two or more marked traffic lanes may ride as near the left-hand curb or edge of such roadway as practicable.

11-1205.1 RIDING TWO ABREAST AND USE OF BICYCLE PATHS[2]

(a) Persons riding bicycles upon a roadway shall not ride more than two abreast except on paths or parts of roadways set aside for the exclusive use of bicycles. Persons riding two abreast shall not impede the normal and reasonable movement of traffic and, on a laned roadway, shall ride within a single lane.

(b) Wherever a usable path for bicycles has been provided adjacent to a roadway, bicycle riders shall use such path and shall not use the roadway.

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[1] Source: J.W. English, National Committee on Uniform Traffic Laws and Ordinances, October 1979.

[2] Changes in these two sections only involved renumbering. Note that section (b) on mandatory use of bicycle paths is controversial. A simple majority of those attending the 1979 meeting of the National Committee and those polled in a subsequent mail survey recommended deletion of this section. However, for a change to occur in the Uniform Vehicle Code requires 35% of the approximately 140 members to vote yes at a meeting and 60% to vote yes in a mail-out ballot. Several states have deleted their mandatory bikepath laws. See Section 4.1.2 for more information.

SUMMARY OF THE BICYCLE PROVISIONS OF THE PALO ALTO ZONING REGULATIONS[1]

(Adopted by the Palo Alto City Council March 20, 1978, and amended June 2, 1978. Chapter 18.83)

Chapter 18.83. Off-Street Parking and Loading Regulations

18.82.050 Basic Regulations: Bicycle Facilities

(a) Bicycle facilities shall be provided for any new building constructed and for any new use established; for any enlargement of an existing building or use; and for any change in the occupancy of any building or the manner in which any use is conducted that would result in additional parking facilities being required, subject to the provisions of this Chapter.

(b) No existing use or structure shall be deemed nonconforming solely because of the lack of bicycle facilities prescribed in this Chapter, provided that bicycle facilities existing on July 30, 1978 shall not be reduced in capacity, design, or function to less than the minimum standards prescribed in this Chapter.

(c) For additions or enlargements of any existing building or use, or any change of occupancy or manner of operation that would increase the bicycle facilities required, the additional facilities shall be required only for such addition, enlargement, or change, and not for the entire building or use.

(d) Bicycle facilities required by this Chapter for any building or use shall not be considered to meet the requirement for any other building or use, except as authorized by the Director of Planning and Community Environment.

(e) Bicycle facilities required by this Chapter, or provided optionally in addition to the minimum requirements prescribed by the Chapter, shall conform to the design standards set forth in Section 18.82.110.

(f) Bicycle facilities required by this Chapter shall be maintained for the duration of the use requiring such facilities, and shall not be used for other purposes.

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[1] A copy of the complete ordinance may be obtained by contacting the City of Palo Alto, City Hall, Palo Alto, California.

(g) All bicycle facilities required by this Chapter shall be located on the same site as the use for which such facilities are required, except as authorized pursuant to Section 18.82.080.

(h) No use shall be required to provide facilities for more bicycles than prescribed by this Chapter, or prescribed by the Director of Planning and Community Environment in accord with this Chapter, or prescribed by any conditional use permit, variance, or Planned Community District. Where additional facilities are provided, they may be considered as meeting the requirement for another use, subject to Section 18.83.080.

18.82.060 Schedule of Off-Street Parking and Bicycle Facility Requirements

(b) In each district, off-street parking facilities and bicycle facilities for each use shall be provided in accord with the following schedule. /see Figure A/.

18.82.070 Additional Requirements

(c) Substitution of bicycle facilities for required vehicle facilities: Eight Class 1 bicycle parking facility spaces in addition to minimum bicycle requirements may be substituted for one required vehicle parking space, up to a maximum of 5 percent of the vehicle spaces required.

18.82.080 Adjustments to Requirements of Schedule

Alternative programs which may be considered by the Director of Planning and Community Environment under this provision include, but are not limited to, the following:

(3) Evidence that a proportion of residents, employees, and/or customers utilize, on a regular basis, bicycle transportation alternatives commensurate with reduced parking requirements.

18.83.110 Design Standards

(c) Bicycle facilities: The following basic standards shall be observed:

(1) Bicycle parking facilities shall include provision for storage and locking of bicycles, either in lockers or in secure racks or equivalent installation in which the bicycle frame and wheels may be locked by the user.

(2) The minimum class of facility required by Section 18.82.060 is shown in the following table. A higher class of facility may be substituted where a Class 2 or Class 3 facility is required. /see Figure B/

(3) Paving is not required, but the outside ground surface shall be paved or planted in a way that avoids mud or dust.

FIGURE A

USE	MINIMUM OFF-STREET PARKING REQUIREMENT	MINIMUM BICYCLE PARKING REQUIREMENT	
		spaces	class*
1. Accessory employee housing or guest cottage	1 space per unit	none	
2. Administrative office services:			
a) In the LM District	1 space for each 27.9 sq. m. (300 sq.ft.) of gross floor area	10% of auto parking	1
b) In all other districts	1 space for each 23.2 sq. m. (250 sq.ft.) of gross floor area	10% of auto parking	1
3. Animal care facilities	1 space for each 32.5 sq. m. (350 sq.ft.) of gross floor area	10% of auto parking or 1 space--whichever is greater	1
4. Automobile service station	1 space for each 32.5 sq. m. (350 sq.ft.) of gross enclosed floor area, plus queue capacity equivalent to the service capacity of gasoline pumps	none	
5. Automotive services:			
a) Enclosed	1 space for each 32.5 sq. m. (350 sq.ft.) of gross floor area	none	
b) Open lot	1 space for each 46.5 sq. m. (500 sq.ft.) of exterior sales, display, or storage site area	none	
6. Business and trade schools	1 space for each 4 persons capacity, or 1 space for each 23.2 sq. m. (250 sq.ft.) of gross floor area, whichever is greater	10% of auto parking	2-covered
7. Churches and religious institutions	1 space for each 4 seats or 4 persons capacity, based on maximum use of all facilities at the same time	10% of auto parking	2
8. Commercial recreation	1 space for each 4 seats or 4 persons capacity	30% of auto parking	1

USE	MINIMUM OFF-STREET PARKING REQUIREMENT	MINIMUM BICYCLE PARKING REQUIREMENT	
		spaces	class*
9. Community facilities, including swim club, tennis club, golf course, community centers, neighborhood centers, and similar activities	1 space for each 4 persons capacity based on maximum use of all facilities	30% of auto parking	1
10. Convalescent facilities	1 space for each 2.5 patient beds	10% of auto parking	2-covered
11. Day care centers, day care homes, family day care homes, and residential care homes	To be established by use permit conditions	To be established by use permit	
12. Drive-up windows providing services to occupants in vehicles	Queue line for 5 cars, not blocking any parking spaces, in addition to other applicable requirements	none	
13. Eating and drinking services:			
a) With drive-in or take out facilities	3 spaces for each 9.3 sq. m (100 sq.ft.) of gross floor area	1 space per 9.3 sq.mt. (100 sq.ft.)	50%-1 50%-3-covered
b) All others	1 space for each 4 seats or 4 persons capacity	10% of auto parking	50%-1 50%-2-covered
14. Financial services:			
a) Bank, savings & loan office	1 space for each 13.9 sq. m. (150 sq.ft.) of gross floor area	10% of auto parking	2-covered
b) Others	1 space for each 23.2 sq. m. (250 sq.ft.) of gross floor area		
15. General business services:			
a) Enclosed	1 space for each 32.5 sq. m. (350 sq.ft.) of gross floor area	10% of auto parking	1
b) Open lot	1 space for each 46.5 sq. m. (500 sq.ft.) of sales, display, or storage site area	10% of auto parking	3
16. Hospitals	1 space for each 1.5 patient beds	10% of auto parking	1

USE	MINIMUM OFF-STREET PARKING REQUIREMENT	MINIMUM BICYCLE PARKING REQUIREMENT	
		spaces	class*
17. Hotel	1 space per guest room; plus the applicable requirements for eating and drinking, banquet, assembly, commercial or other as required for such use, less 75 percent of the spaces required for guest rooms	10% of auto parking	2-covered
18. Lodging	1 space for each lodging unit, in addition to other residential use requirements	1 space per lodging unit	1
19. Manufacturing:			
a) In the LM District	1 space for each 27.9 sq.m. (300 sq.ft.) of gross floor area	10% of auto parking	1
b) In all other districts	1 space for each 46.5 sq.m. (500 sq.ft.) of gross floor area	10% of auto parking	1
20. Medical, professional, and general business offices:			
a) In the LM District	1 space for each 27.9 sq.m., (300 sq.ft.) of gross floor area	10% of auto parking	1
b) In all other districts	1 space for each 23.2 sq.m. (250 sq.ft.) of gross floor area	10% of auto parking	1
21. Mortuaries	1 space for each 4 seats or 4 persons capacity, plus funeral procession queue capacity of 5 cars	none	
22. Multiple family residential use	1.25 spaces per studio unit, 1.5 spaces per 1 bedroom unit, and 2 spaces per 2 bedroom or larger unit; of which at least one space per unit must be covered	1 space per unit	1
23. Personal services	1 space for each 13.9 sq.m. (150 sq.ft.) of gross floor area	10% of auto parking	2-covered
24. Private clubs, lodges, and fraternal organizations	1 space for each 4 seats or 4 persons capacity based on maximum use of all space at one time	10% of auto parking	2
25. Research and development:			
a) In the LM District	1 space for each 27.9 sq.m. (300 sq.ft.) of gross floor area	10% of auto parking	1
b) In all other districts	1 space for each 23.2 sq.m. (250 sq.ft.) of gross floor area	10% of auto parking	1

USE	MINIMUM OFF-STREET PARKING REQUIREMENT	MINIMUM BICYCLE PARKING REQUIREMENT	
		spaces	class*
26. Retail:			
a) Intensive	1 space for each 13.9 sq.m. (150 sq.ft.) of gross floor area	10% of auto parking	2-covered
b) Extensive	1 space for each 32.5 sq.m. (350 sq.ft.) of gross floor area	10% of auto parking	2-covered
c) Open lot	1 space for each 46.5 sq.m. (500 sq.ft.) of sales, display, or storage site area	10% of auto parking	3
27. Schools and educational facilities:			
a) Grades K-8	2 spaces per teaching station	1 space per every 3 students	3-enclosed
b) Grades 9-12	4 ~~[illegible]~~ spaces per teaching station	1 space per every ~~[illegible]~~ 2 students	3-enclosed
28. Shopping Center	1 space for each 25.6 sq.m. (275 sq.ft.) of gross floor area	10% of auto parking	1
29. Single family residential use:			
a) In the O-S District	4 spaces per unit, of which one space must be covered	none	
b) In all other districts	2 spaces per unit, of which one space must be covered	none	
30. Two family residential use	1.5 spaces per unit, of which one space per unit must be covered	none	
31. Warehousing and distribution:			
a) In the LM District	1 space for each 27.9 sq.m. (300 sq.ft.) of gross floor area	none	
b) In all other districts	1 space for each 92.9 sq.m. (1,000 sq.ft.) of gross floor area	none	
32. Any use not specified	To be determined by the Director of Planning and Community Environment	To be determined by the Director of Planning and Community Environment	

FIGURE B

Class	Purpose and Description
1	For long-term parking (one-half hour or more): Lockers or check-in for high security and/or total protection from the weather.
2	For short-term parking (less than one-half hour): Ability for user to lock both wheels and frame, with user providing the lock.
3	For short-term parking: A stationary object, such as a "bicycle rack" to which the user can secure both wheels and the frame with a user-provided 1.8 meter (6 foot) cable (or chain) and lock.

(4) Bicycle spaces shall be racks or lockers anchored so that they cannot be easily removed. Racks shall be so designed that both wheels and frame of a bicycle can be locked securely to it with a heavy chain, cable, or padlock. Lockers shall be so designed that an unauthorized person cannot remove a bicycle from them.

(5) Fixed objects which are intended to serve as bicycle racks but not obviously intended for such purposes shall be clearly labeled as available for bicycles.

(6) If a room or common locker not divided into individual lockers or rack spaces is used, one bicycle space shall consist of a rectangular area not less than 0.6 meter (2 feet) wide by 1.8 meters (6 feet) long. There should be a minimum aisle width of 1.5 meters (5 feet).

(7) Location criteria: Care should be taken to locate the bicycle facility at least as convenient as the most convenient car parking, and as close to the desired entrances as possible without interfering with pedestrian traffic. Bicycle and auto parking areas should be separated by some form of barrier to eliminate the possibility of a bike being hit by a car.

(8) User safety and convenience criteria: The Director of Planning and Community Environment shall have the authority to review bicycle racks for design with respect to safety and convenience.

(9) Construction and appearance criteria: Lockers should be harmonious with their environment both in color and design. Signs should clearly designate the area as a bicycle parking facility. Parking device designs should be incorporated whenever possible into street furniture. There should be sufficient space between devices so that the use of one does not interfere with the other bicycles or devices. The parking device should allow for maximum flexibility in grouping and placement.

APPENDIX E

POTENTIAL FEDERAL FUNDING SOURCES FOR BICYCLE PROGRAMS AND FACILITIES

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POTENTIAL FEDERAL FUNDING FOR BICYCLE FACILITIES

By Nina Dougherty Rowe

Administering Agency/Contact	Legislative Authority	Funding Amount Not Solely for Bike Progs.	Purpose	Comment
Department of Transportation (DOT) Federal Highway Administration (Tom Jennings - 202 426-0314)	Federal-Aid Highway Program Manual (6-1-1-1)	FY 79 - Total $6.9 Billion (Includes highways, mass transit, etc.) No limit per state 70/30 cost share (intrastate) 90/10 cost share (interstate)	Funds are from highway trust fund gas tax for all types of transportation. Traditionally the bulk of the money has gone to highways. Bike facilities are an eligible item for the use of these highway funds.	
Federal Highway Administration (FHWA)	Title 23 U.S. Code Federal Aid to Highway Act Section 217	FY 78 & 79 $45 million per year with a maximum of $2.5 Million per state a year 80/20 cost share-planning 70/30 cost share-construction	These funds are also a part of the highway trust fund for bikeway/walkway projects that are not related to federal aid highway projects	Funds are competitive with highway projects Apply through State Highway Departments
FHWA	Surface Transportation Assistance Act, Section 141	$20 million annually, 1979-82	For bikeways; bicycle lane or path, bicycle traffic control devices, bicycle shelter or parking or bicycle support facility to serve bicycles and persons using bicycles.	Funds have not yet been appropriated by Congress.
National Highway Traffic Safety Administration Governor's State Highway Safety Representative	Title 23 U.S. Code Highway Safety Act of 1966	FY 78 $137 Million per state ceiling based on formula of population and miles of public roads. (Includes all safety programs.) 70/30 cost share 3 years to obligate	Seed money for states to develop programs to meet highway safety needs -- Education enforcement and knowledge of rules of the road must be a part of annual work program of highway safety plan. Bicycle safety programs eligible.	FHWA administers portions of these funds related to engineering studies to determine facility related countermeasures.

Administering Agency/Contact	Legislative Authority	Funding (Amount) Not Solely for Bike Prog's	Purpose	Comment
Department of Transportation (DOT)				
Urban Mass Transportation Administration (UMTA)	Urban Mass Transportation Act of 1964 as amended	FY 79 $2.9 Billion (includes all mass transit funding)	Mass transit activities and studies. Bicycle studies and plans eligible Bike study must be an element included in continuing transportation planning processes (3 c's)	A $90,000 bicycle demand study in Washington, D.C. was funded by UMTA technical assistance funds.
Metropolitan Planning Organization (MPO)		Unified Work Program for Transportation Planning Technical Assistance Funds		
UMTA/MPO	Urban Mass Transportation Act of 1964 as Amended	Mass Transit Grants	For mass transit related construction. Feeder routes to transit facilities and bicycle parking facilities at transit stations. Eligible.	May 1974 letter from Secretary of UMTA
UMTA/MPO	Transportation Improvement Program Regulations (Sept. 17, 1975, Federal Register, Vol. 40, No. 181)	Transportation Improvement Program	For transportation projects implementation next 3-5 years. The transportation system management plan an element of the TIP, explains how efficient use will be made of existing facilities, utiliting low-cost, non-capital improvements-i.e., carpooling, bus lanes, etc. Bicycle paths, exclusive lanes, secure and convenient storage areas for bicycles; and other bicycle facilitation measures are eligible for these UMTA funds.	The improvement must be part of the TIP proposed by the MPO
Environmental Protection Agency				
State Environmental Protection Agency	Clean Water Act of 1977 Section 201(g)(6) and Section 208(B)(2)(A)	FY 78 $4.5 Billion (Sewage treatment). State limit based on formulae.	For sewage treatment projects which clean up land. Incidental multiple use projects which take advantage of the recreation, open space opportunities are eligible for some of the funds. Bikeways can be constructed along the interceptor sewer lines.	Must be a part of continuing water quality planning process. Applications through State Environmental Protection Agency. $34,000 (less than 1%) of the $1.1 Million to construct a sewer right of way was used to develop a 7 mile bike trail in Maryland.

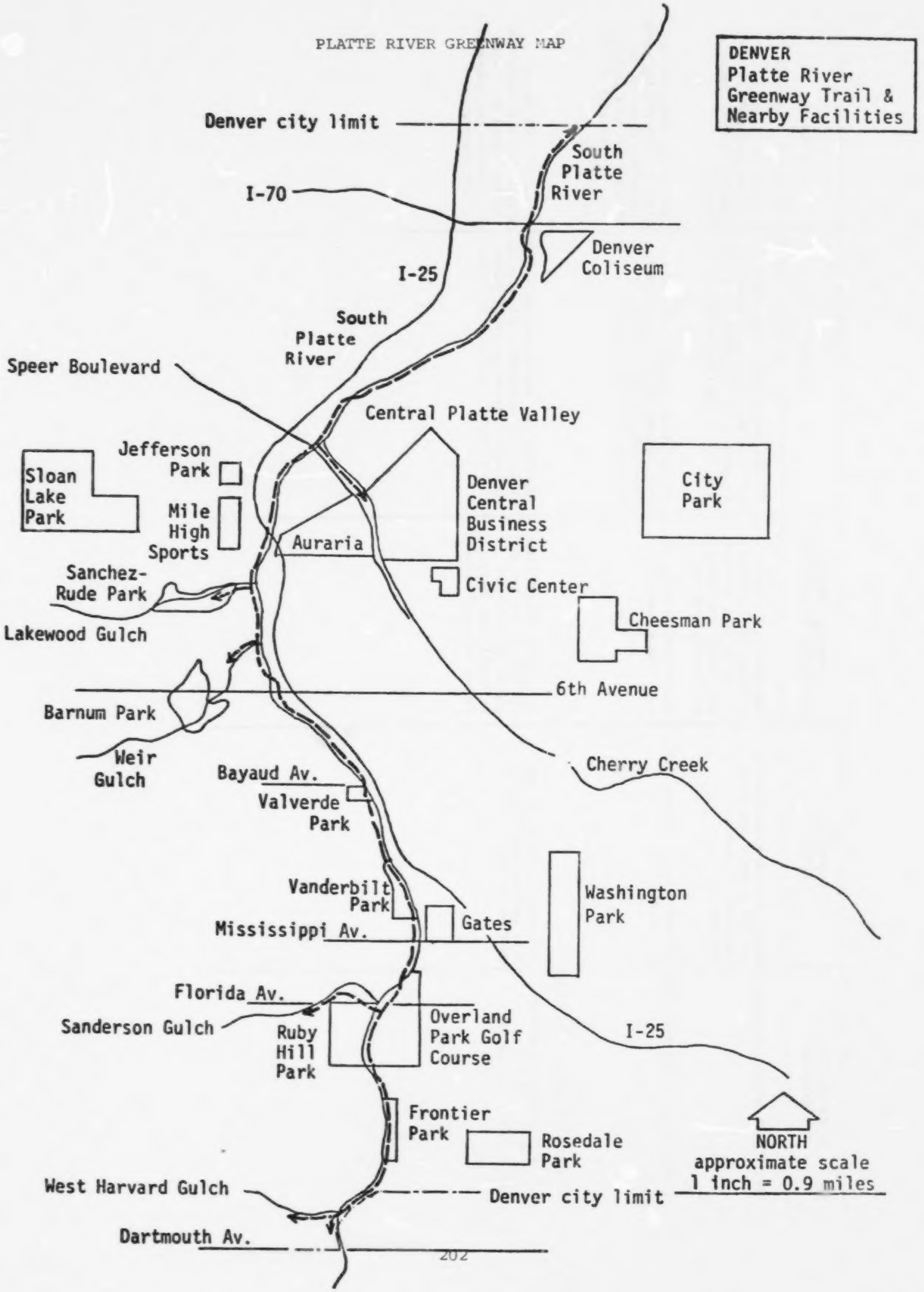
Administering Agency/Contact	Legislative Authority	Funding (Amount) Not Solely for Bike Prog's	Purpose	Comment
Department of Housing and Urban Development				
City Hall Community Planning	Housing Act of 1977 as amended	FY 77 $3.2 Billion FY 78 $3.6 Billion FY 79 $3.75 Billion (Community Development) "Entitlement" for metropolitan cities and urban counties (populations of 50,000 + 200,000 respectively) 20% to non-metropolitan areas 3% discretionary funds to programs like New Communities	Community Development Block Grant criteria: suitable living environment and expanded economic opportunities for low income groups, & adequate housing. Bikeways eligible.	Application through Mayor and City Council
Department of Interior (DOI)				
Heritage Conservation and Recreation Service State Outdoor Recreation Liaison Office	Railroad Revitalization and Regulatory Reform Act of 1976, Section 809 Interim Regulations October 11, 1977, Federal Register	FY 78 $5 Million 90/10 cost share maximum	For conversion of abandoned railroad rights-of-way to recreation and conservation use.	S. 1793 to amend the Railroad Revitalization and Regulatory Reform Act would authorize $75 Million for the fiscal year ending Sept. 30, 1979 90/10 cost share
Heritage Conservation and Recreation Service	Land & Water Conservation Fund Act of 1965 as amended	FY 78 $600 Million FY 79 $750 Million FY 80-89 $900 Million per year 50/50 cost share	For outdoor recreation facilities. Bike facilities eligible.	Bike facilities must be a part of the State Comprehensive Outdoor Recreation Plans; must be sponsored by public agency; priority to urban areas; for planning, acquisition & development; State determines to which projects and in what order money awarded; special consideration to improving environment.

Administering Agency/Contact	Legislative Authority	Funding (Amount) Not Solely for Bike Prog's	Purpose	Comment
Department of Interior (DOI)				
Heritage Conservation and Recreation Service State Historic Preservation Officer	The National Historic Preservation Act of 1966	FY 78 $35 Million (for historic preservation) State limit based on a formula	For acquisition or development historic preservation purposes, of districts, sites, buildings, structures, objects; preparations of statewide historic preservation surveys and plans; must be in accord with comprehensive statewide plan approved by Secretary of Interior. Historic property must be listed in National Register in order to receive grants.	For example, Civil War Trail: bicycle facility that follows the Battle of Atlanta
Bureau of Reclamation	Federal Water Project Recreation Act (Public Law 89-72) (Section 2(a))	Projects individually authorized in line item of budget. Joint costs on new projects borne by Federal Government; 50/50 cost sharing except in federally managed areas.	Recreational potential must be considered on federal multiple purpose resource projects in which the land is usually purchased by the Federal government. Necessary facilities on new and old projects are funded.	Involves a long process of study, design, construction. The public is well informed of the projects through public hearings. Non-federal agency manages the recreation projects.
Department of Defense				
U. S. Army Corp of Engineers	Federal Water Project Recreation (PL 89-72)	FY 78 $110 Million (Water Resource Projects). Cost sharing (1/2 of separable costs)	For Water Resources Projects. Multipurpose projects eligible for funds.	Same as Above - Process takes 10-12 years. Non-federal agency must agree to assume 1/2 of separable costs & all maintenance, operation, replacement & administration costs for recreation facility; otherwise, only minimum facilities for protection of public health & safety will be provided.

Administering Agency/Contact	Legislative Authority	Funding (Amount) Not Solely for Bike Prog's	Purpose	Comment
Department of Health, Education and Welfare				
Office of Education State Education Office	Title I, II, IV & V of Elementary & Secondary Education Act of 1965 and Title I of Higher Education Act of 1965	Grant-in-Aid programs	Must be used in association with educational improvement or research depending on which grant applied for.	A 3-year, $90,000 a year bicycle safety study to develop a safety town in Sterling, Illinois was funded from these HEW funds. Competitive with reading projects, etc.
Department of Labor				
Manpower Administration	Neighborhood Youth Corps	Up to 90% of cost of approved projects	Projects which contribute to conservation, development, management of natural resource or recreation area.	Not more than 12.5% of program funds can be spent in one state each fiscal year. Priority given to high training potential.
	Operation Mainstream	Up to 90% of cost of approved projects	Improve physical or social environment of local communities (designed to prepare chronically unemployed adults for permanent job).	Not more than 12.5% of program funds can be spent in one state each fiscal year.

Administering Agency/Contact	Legislative Authority	Funding (Amount) Not Solely for Bike Prog's	Purpose	Comment
Appalachian Regional Commission	Appalachian Redevelopment Act of 1965 (Public Law 89-4) Supplemental Grants Section 214	Increase Land & Water Conservation Fund Sharing to 80% or used to supplement almost any Federal Grant-in-Aid Program	For improving Appalachian region. Bikeways may be part of authorized highways and access roads or a mining land reclamation project.	Affects 13 states. Must be part of State Appalachian Development Programs
General Services Administration	General Services Act of 1949 as amended	Administration Funds in each Federal Agency	For maintaining federal building. Bike parking facilities; currently bikeracks provided at federal buildings free upon request.	Bike locker demonstrations. Study of bike parking needs new policy to be set in Spring which will probably allow for purchase of bike lockers.
National Endowment of the Arts Public Information Office 2401 E. St., N.W. Washington, D.C. 20506	National Foundation of the Arts and the Humanities Act of 1965 (PL 209)	FY 79 Total $120 Million ($3-1/2 million for small grants, professional fellowship and design; Design Project Fellowship)	For Planning; design and feasibility of artistic endeavors, and programs for public awareness, small grants to non-profit, tax exempt individuals	48 out of 1700 demand grants were transportation related. Send for a copy of "Guide to the Endowment of Arts Program".

PLATTE RIVER GREENWAY MAP


DENVER
Platte River
Greenway Trail &
Nearby Facilities
Denver city limit
South
Platte
River
I-70
Denver
Coliseum
I-25
South
Platte
River
Speer Boulevard
Central Platte Valley
Jefferson
Park
Sloan
Lake
Park
Mile
High
Sports
Denver
Central
Business
District
City
Park
Auraria
Sanchez-
Rude Park
Civic Center
Cheesman Park
Lakewood Gulch
6th Avenue
Barnum Park
Weir
Gulch
Cherry Creek
Bayaud Av.
Valverde
Park
Vanderbilt
Park
Washington
Park
Mississippi Av.
Gates
Florida Av.
Sanderson Gulch
Ruby
Hill
Park
Overland
Park Golf
Course
I-25
Frontier
Park
Rosedale
Park
NORTH
approximate scale
1 inch = 0.9 miles
West Harvard Gulch
Denver city limit
Dartmouth Av.

FUNDING SOURCES FOR PLATTE RIVER GREENWAY
BIKE/BIKE TRAIL AND OTHER RECREATION FACILITIES

OVERVIEW OF CONTRIBUTIONS TO DATE . . .

March, 1979

LOCAL (Denver)

$2,000,000	Mayor's Revenue Sharing Fund (1974)
850,000	City Council Match Appropriation (1974)
250,000	Capital Improvement Fund (1978)
$3,100,000	TOTAL LOCAL FUNDS (41%)

STATE (Colorado)

$ 740,000	Conservation Trust Fund (1975-79)
150,000	Urban Drainage and Flood Control District (1975-77)
40,000	Centennial-Bicentennial Commission (1976)
305,000	State Trails Committee (1976-78)
100,000	Auraria General Revenue Funds (1976)
$1,335,000	TOTAL STATE FUNDS (18%)

FEDERAL

$ 625,000	Land and Water Conservation Fund (HCRS) (1975-78)
300,000	Secretary's LWCF Contingency Fund (HCRS) (1976)
384,000	Community Development Fund (1976)
546,000	Highway Urban Systems Fund (1976-78)
220,000	Local Public Works Employment Act (EDA) (1977)
$2,075,000	TOTAL FEDERAL FUNDS (27%)

PRIVATE

$ 780,000	Gates Foundation (1976)
100,000	Boettcher Foundation (1976)
53,000	Fishback Foundation Trust (1976)
28,000	Pepsi Cola (1976)
29,000	First of Denver Savings Account Promotions (1975-76)
90,000	Estimated Individual Contributions (1975-78)
$1,080,000	TOTAL PRIVATE FUNDS (14%)

$7,591,000	TOTAL FUNDING TO DATE (100%)

PLATTE RIVER GREENWAY FOUNDATION 1421 COURT PLACE DENVER, COLORADO 80202 (303) 623-2252

APPENDIX F

DOT BICYCLE LEGISLATION

- Section 217, Title 23, Bicycle Transportation and Pedestrian Walkways
- Section 141, PL 95-599, Bicycle Program
- Section 682, PL 95-619, Bicycle Study

TITLE 23, HIGHWAYS, UNITED STATES CODE[1]

Section 217, BICYCLE TRANSPORTATION AND PEDESTRIAN WALKWAYS

(a) To encourage energy conservation and the multiple use of highway rights-of-way, including the development, improvement, and use of bicycle transportation and the development and improvement of pedestrian walkways on or in conjunction with highway rights-of-way, the States may, as Federal-aid projects, construct new or improved lanes, paths, or shoulders; traffic control devices, shelters for and parking facilities for bicycles; and pedestrian walkways. Sums apportioned in accordance with paragraphs (1), (2), and (6) of section 104(b) of this title shall be available for bicycle projects and pedestrian walkways authorized under this section and such projects shall be located and designed pursuant to an overall plan which will provide due consideration for safety and contiguous routes.

(b) For all purposes of this title, a bicycle or pedestrian walkway project authorized by subsection (a) of this section shall be deemed to be a highway project, and the Federal share payable on account of such bicycle project or pedestrian walkway shall be that provided in section 120 of this title.

(c) Funds authorized for forest highways, forest development roads and trails, public lands development roads and trails, park roads and trails, parkways, Indian reservation roads, and public lands highways shall be available, at the discretion of the development charged with the administration of such funds, for the construction of bicycle and pedestrian routes in conjunction with such trails, roads, highways, and parkways.

(d) No motorized vehicles shall be permitted on trails and walkways authorized under this section except for maintenance purposes, and, when snow conditions and State or local regulations permit, snowmobiles.

(e) Not more than $45,000,000 of funds authorized to be appropriated in any fiscal year may be obligated for projects authorized by subsections (a) and (c) of this section, and no State shall obligate more than $2,500,000 for such projects in any fiscal year.

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[1] Source: United States Code Annotated, Title 23, Highways, Cumulative Annual Pocket Part, (St. Paul, Minn.: West Publishing Co.), 1978.

SURFACE TRANSPORTATION ASSISTANCE ACT OF 1978, PL 95-599, Nov. 6, 1978

BICYCLE PROGRAM, Section 141.

(a) For the purposes of this section, the term-
- (1) "Secretary" means the Secretary of Transportation
- (2) "bikeway" means a new or improved lane, path, or shoulder, a traffic control device, lighting, or a shelter or parking facility for bicycles;
- (3) "State" means any one of the fifty States, the District of Columbia, or Puerto Rico.

(b) The Secretary shall, by regulation, establish design and construction standards for bikeway construction projects for which grants are authorized in subsection (c) and section 217 of title 23, United States Code. Such regulations shall contain criteria for pavements, adequate widths, sight distances and lighting; appropriate design speeds and grades; and such other requirements as the Secretary may deem necessary.

(c) The Secretary is authorized to make grants to States and to political subdivisions thereof for (1) the construction of bikeways which (A) comply with regulations promulgated pursuant to subsection (b), or (B) prior to promulgation of such regulations, reflect current state of the Art design standards, or (2) nonconstruction programs or projects which can reasonably be expected to enhance the safety and use of bicycles. Projects in urban areas financed with grants under this subsection shall be in accordance with the continuing, comprehensive planning process in section 134 of title 23, United States Code.

(d) The Federal share of any project or program for which a grant is made under subsection (c) shall not exceed 75 per cent.

(e) Grants made under this section shall be in addition to any sums available for bicycle projects under section 217 of title 23, United States Code.

(f) Section 109(f) of title 23, United States Code, is amended by adding after the words "median strips," the following: "bikeways".

(g) Section 109 of title 23, United States Code, is amended by adding a new subsection as follows: "(n) The Secretary shall not approve any project under this title that will result in the severance or destruction of an existing major route for nonmotorized transportation traffic and light motorcycles, unless such project provides a reasonably alternate route or such a route exists.".

(h) Section 217(a) of title 23, United States Code, is amended to read as follows:
"(a) To encourage energy conservation and the multiple use of highway rights-of-way, including the development, improvement, and use of bicycle transportation and the development and improvement of pedestrian walkways on or in conjunction with highway rights-of-way, the States may, as Federal-aid highway projects, construct

new or improved lanes, paths, or shoulders; traffic control devices, shelters for and parking facilities for bicycles; and pedestrian walkways. Sums apportioned in accordance with paragraphs (1), (2), and (6) of section 104(b) of this title shall be available for bicycle projects and pedestrian walkways authorized under this section and such projects shall be located and designed pursuant to an overall plan which will provide due consideration for safety and contiguous routes.

(i) There is authorized to be appropriated to the Secretary to carry out subsection (c), for each of the fiscal years ending September 30, 1979, September 30, 1980, September 30, 1981, and September 30, 1982, out of the Highway Trust Fund $10,000,000 and $10,000,000 out of any other money in the Treasury not otherwise appropriated.

NATIONAL ENERGY CONSERVATION POLICY ACT, PL 95-619, November 9, 1978

Section 682, BICYCLE STUDY

(a) The Congress recognizes that bicycles are the most efficient means of transportation, represent a viable commuting alternative to many people, offer mobility at speeds as fast as that of cars in urban areas, provide health benefits through daily exercise, reduce noise and air pollution, are relatively inexpensive, and deserve consideration in a comprehensive national energy plan.

(b) Not more than one year after the date of enactment of this Act, the Secretary of Transportation shall complete a study of the energy conservation of potential bicycle transportation, determine institutional, legal, physical, and personal obstacles to increased bicycle use, establish a target for bicycle use in commuting, and develop a comprehensive program to meet these goals. In developing the program, consideration should be given to educational programs, federal demonstrations, planning grants, and construction grants. The Secretary of Transportation shall submit a report to the President and to Congress containing the results of such a study.